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THE SIZES OF THE INFECTIVE PARTICLES IN THE MOSAIC DISEASE OF TOBACCO

B. M. DUGGAR

Physiologist to the Missouri Botanical Garden, in Charge of Graduate Laboratory
Professor of Plant Physiology in the Henry Shaw School of Botany of Washington University

AND JOANNE L. KARRER

Research Assistant to the Missouri Botanical Garden

INTRODUCTION

The present investigation is one of a series of studies in progress or proposed with the idea of gaining further information concerning the constitution and behavior of the causal agency in the mosaic disease of tobacco or other mosaic diseases. We have undertaken this work with the feeling that all facts tending to throw new light upon any physical or chemical characteristic of the agency concerned might be helpful in the study of some or all mosaic diseases, and likewise, perhaps, in the study of ultramicroscopic agencies causally related to certain human and other animal diseases. The term agency rather than organism is employed because it is hoped to avoid any possible prejudice to the direction in which such research may lead. It is distinctly felt that any assumption tacitly ascribing such diseases, because infectious, to organisms of the known or usual types may serve in the end to restrict rather than broaden the investigation. The term "virus" will be used in this paper interchangeably with agency.

It is, we believe, more frequently stated that the active agency

in the mosaic disease of tobacco is a filterable virus, the "contagium vivum fluidum" of Beijerinck ('98). Confirmation of Beijerinck's porous filter experiments is not lacking. On the other hand, the agency in this disease has been found to be held back, or non-filterable, when certain filters are employed. Experiments establishing the last-mentioned fact have been contributed by the work of Allard ('16) and also for the cucumber mosaic by Doolittle ('20). All too frequently, it would seem, our knowledge respecting the particles or individuals of the so-called filterable organisms has been chiefly the fact of the passage of infective particles through some bacteriological filter, more particularly the Chamberland or the Berkefeld, with no particular effort to effect a more precise standardization of both the filters permitting the passage of such particles and of those filters restraining them, so as to permit a more definite measurement of the particles concerned.

In this work some of the methods of ultrafiltration have been employed. In general, the method or technique of the experimentation may be divided into 3 phases: (1) filtration (or diffusion) of diseased juice through various ultrafilters, (2) inoculation of healthy plants with the filtrates obtained, and (3) the standardization of the filters by a determination of their capacity to permit or prevent the passage of colloidal particles of known, or approximately known, sizes.

PRELIMINARY EXPERIMENTS

Preceding a discussion of the later work under 3 headings corresponding to the 3 phases, or aspects, above noted, it seems well to report certain preliminary data, secured during the previous year, which led to the more definite formulation of the chief experimental work reported in this paper. The preliminary experiments consisted of: (1) a filtration test of infected juice through a Livingston spherical atmometer cup, (2) filtration through layers of 1.5 and 3.0 per cent agar, (3) diffusion through Schleicher and Shüll parchment diffusion shells.

In these preliminary experiments with the atmometer the filter cup was partially filled with the juice, and suction was

then applied, a colorless filtrate being obtained with a pressure of about .5 atmosphere or more. The agar filtrates were obtained in the first instance by covering a Buchner funnel with filter-paper and then pouring on and congealing a layer of the agar to a depth of about 3 millimeters, being careful also to coat the sides of the funnel to a height that would be greater than the depth of the juice employed. Suction was then applied as before; filtration, however, was extremely slow. In the other case a cylindrical porous atmometer tube was partially filled with the melted agar, then by revolving the filter in a position almost horizontal and subsequently rapidly revolving it on a block of ice, as in the preparation of an Esmarch rolled plate, a layer of the agar was deposited throughout the length of the cylinder. In the case of the diffusion shells these were filled about half full with the diseased juice and then immersed to the depth of the inner liquid in small beakers of sterile distilled water. These were left for a period of 4 days at a temperature of about 18° C. in order that slow diffusion might proceed. The utmost care was used to prevent contamination of the exterior of any of the vessels employed. Inoculation experiments were made from each of the above tests, as indicated in the following outline.

TABLE I

INFECTION OF TOBACCO PLANTS WITH MOSAIC DISEASE AFTER FILTRATION OR DIFFUSION OF THE DISEASED JUICE

Experiment number	Nature of filter or diffusion shell	Source of infection	Number of plants diseased
1	Spherical atmometer cup	Filtrate	10
2	Control	Control (dt. water)	0
3	1.5% agar layer	Filtrate	0
4	3.0% agar layer	Filtrate	0
5	Parchment shell A	Liquid outside of tube	0
6	Parchment shell A	Liquid inside of tube	10
7	Parchment shell B	Liquid outside of tube	0
8	Parchment shell B	Liquid inside of tube	9

In the above experiments 10 tobacco plants were inoculated in each case. These were thrifty young plants of a common

variety, Kentucky burley. The inoculations were made on March 2 and final notes were taken March 16, though the plants were actually observed until April 11. No observations were made on temperature and humidity, but conditions in the greenhouse were such as to encourage rapid growth. These experiments were conclusive in showing that the virus or disease agency does not under our filtration conditions penetrate through agar of the consistencies employed, nor does it diffuse through a parchment membrane. On the other hand, the infected particles pass readily through the spherical atmometer cup. In this connection it should be observed that while the diffusion experiments lasted for a period of 4 days it has been shown (Allard, '16) that there is little, if any, lessening of pathogenicity in solutions subjected to more or less fermentation. The fact that the infected juice from within the diffusion shells invariably induced the disease is sufficient evidence that the growth of foreign organisms was not a factor worthy of consideration. The method of inoculation employed in the above experiments was the same as that described below for the more elaborate work here reported, and the reader is referred to the later description for the method employed.

It should be stated that several of the porous spherical atmometer cups have been tested in this laboratory under similar conditions and have been found invariably to prevent the passage of vegetative cells or of spores of *Bacillus subtilis*, and the subsequent results will show that this particular filter possesses finer pores than the Mandler diatomaceous filter. The indications furnished by Beijerinck as to the capacity of the virus to pass certain porous filters was again confirmed. On the other hand, Beijerinck claims a very slow diffusion, or penetration, of the virus into agar. The concentration of the agar is not noted. For the present the writers are unable to discuss the merits of this claim, since our own experiments represent direct filtration results, and the agar employed was probably denser than that used by Beijerinck.

FILTRATION OF THE DISEASED JUICE THROUGH ULTRAFILTERS

After the preliminary work reported above it was clear to the writers that it would be desirable to filter the diseased tobacco

juice through each of a series of porcelain or other filters of fairly well-determined porosity which might be subsequently standardized in a definite manner; but at the time no such series of filters could be found. Celloidin membranes did not seem to offer the range of porosity required. A little experimentation with rate of water flow, however, indicated that no inconsiderable range of possibilities was available in the form of the ordinary porcelain filters and atmometers of the laboratory. Accordingly, a series of filters was arranged consisting of a Mandler filter, a porous spherical atmometer cup, 2 cylindrical atmometer tubes, 2 cylindrical atmometer tubes infiltrated with precipitation films of $Al(OH)_3$, and 2 specially prepared celloidin membranes. Considerable preliminary work led to the selection of this series. It may be well also to indicate that the particular spherical atmometer cup used in this work proved to be the only one possessing pores noticeably finer than the average of these cups. This cup was one of the earlier ones distributed for work in atmometers.

Filters employed.—The porcelain filters were, where necessary, thoroughly cleaned and all were boiled in distilled water prior to use. The Mandler filter employed was No. 5090 of the Arthur H. Thomas catalog, $2\frac{1}{2}$–$5\frac{1}{8}$ inches, tested to 6–12 pounds air pressure without passing air bubbles. The cylindrical filters impregnated with $Al(OH)_3$ were prepared in the following manner: The filter tubes were filled with 5 per cent $AlCl_3$ and after allowing time for this to penetrate the walls thoroughly the tubes were suspended in beakers of 1 per cent NH_4OH until it appeared that the alkali had penetrated the cup, shown by a slight turbidity. The tubes were then carefully rinsed.

The celloidin membranes were prepared according to the method of Brown ('15) by which films of relatively great permeability can be obtained. The membranes were formed on the inside of beakers. An 8 per cent solution of Schering's celloidin in an equal volume of ether and absolute ethyl alcohol was poured into a beaker and allowed to drain over another beaker for 10 minutes. The beaker was then immediately immersed in distilled water. After about a minute the membrane was loosened from the sides of the beaker, washed in the water

for a short while, and allowed to dry over night at laboratory temperature. Since a very permeable membrane was desired, the film was put into 96 per cent ethyl alcohol for 24 hours at 20° C. and then thoroughly washed in water for a day. The films were cut into sizes large enough to fit over the broad end of a thistle tube. Tests of these membranes for leakage by the air bubble method were concurrent with the filtration experiments.

Preparation of the juice from diseased leaves.—A simple standard method, long in use in this laboratory for preparing the infected juice to be employed in experimental work, was adopted. This consists in pulping a known weight of the diseased leaves in a large mortar with a heavy pestle, then adding an equal weight of water and continuing the pulping until the leaf tissue is thoroughly crushed. The material is then filtered through cotton on a Buchner or ridged funnel. This diluted juice is used directly in the inoculation experiments.

Filtration of the juices.—In these experiments it was necessary to use every precaution possible to prevent accidental contamination of surfaces or vessels that might come in contact with the filtered juice. It was soon found that this could best be done by lowering the wet filter into the vessel containing the diseased juice to a suitable depth and then drawing the filtrate into the tube, rather than to draw the current from within outward. By the method indicated, as soon as sufficient filtrate had been drawn into the filter cup or tube, the filtration was stopped, and with sterile pipettes a quantity of the clear filtered juice was taken from within the cup and placed in clean vessels for use in inoculation.

With the various porcelain filters the water pump reduced the air pressure to 1/15–1/30 of an atmosphere. The filtrate was rapidly obtained in the case of the Mandler filter and also very nearly so rapidly in the case of the spherical atmometer cup. In fact, the time required to obtain a sufficient amount of the filtered juice was about 15 minutes with the spherical atmometer cup, and 30–45 minutes with the cylindrical ones. According to all the evidence at present available, such differences in pressure as were used do not materially influence the size of the

particles which may pass through, but primarily the rate of passage. The writers feel that it may be necessary to determine carefully the influence of the time interval; but since in these experiments comparative rather than fundamental results were desired, the phase of the filtration problem just referred to has not been experimentally studied.

With the celloidin membrane it was necessary to filter very cautiously so that a longer period of time at a pressure of 0.8 atmosphere was given. In this case, too, the membrane was fastened over the bell of a thistle tube. The diseased juice was then added through the tube, and the thistle tube—with the stem of the latter inserted through a rubber cork—was placed in a wide-mouthed bottle and lowered almost to the bottom, sufficient water being added to the bottle to just cover the membrane. Aspiration was then applied to the bottle through a second tube entering to just below the surface of the cork.

Inoculation Experiments with Filtered Juices

Technique of inoculation.—All inoculations were made by injuring the surface of the growing plant in 3 different areas, one from near the growing tip, one at the base of a young leaf, and another farther down the stem, or in the case of younger plants, just above the surface of the ground. These injuries were made with a needle or a fine pointed scalpel and in each case a drop of the infected juice was smeared over the injury and somewhat worked into it. This type of injury proved generally more effective than merely rubbing the stem or leaf as has been done in some cases. It was generally found advisable to make the inoculations in the late afternoon, the greenhouse being thoroughly watered afterward so as to prevent a too rapid drying of the injured surfaces.

Since there was some danger that the operator handling the filtration apparatus might come more or less in contact with particles of the diseased juice it was arranged that all inoculation work should be carried out by a different operator. Moreover, in most cases the different inoculation experiments were made by different operators. Where this was not possible every

precaution was taken with reference to contact with the clothing or hands. Between different inoculations the hands were washed with soap and water, then washed or rinsed with 1–500 formaldehyde, which has been found an effective antiseptic for the purpose, although when added to the juice in this concentration it is relatively ineffective.

Results of inoculation experiments.—There are given in table II the results of a series of inoculation experiments, with the filtered juices already described, conducted during November, 1921. In accordance with the indications previously given the inoculations were made on plants about 3 months old, which had been grown under greenhouse conditions and at this stage were in 5-inch pots. Good growing conditions were maintained throughout the experiment, since it has been repeatedly shown in our work that such conditions are favorable for most rapid production of unmistakable symptoms of the mosaic disease.

TABLE II

INOCULATION EXPERIMENTS MADE ON HEALTHY TOBACCO PLANTS, WITH FILTERED JUICES OBTAINED FROM PLANTS AFFECTED WITH THE CHARACTERISTIC MOSAIC DISEASE

Exp. No.	Number of plants	Source of the inoculation	No. of plants with mosaic after 18 days
1	20	Filtrate, Mandler filter	19
2	20	Filtrate, spherical atmometer cup	18
3	20	Filtrate, cylindrical atmometer tube A	1
4	20	Filtrate, cylindrical atmometer tube B	0
5	20	Filtrate, Atm. C. infilt. with $Al(OH)_3$	0
6	20	Filtrate, Atm. D. infilt. with $Al(OH)_3$	1†
7	20	Filtrate from celloidin membrane E	1†
8	—	Filtrate from celloidin membrane F*	—
9	20	Control, juice from diseased plant	19
10	20	Control, distilled water	0

* This membrane leaked and no inoculations were made.

† These two plants exhibited pronounced symptoms of mosaic in so short a time after inoculation that they are thought to have been accidental contaminations.

From the results obtained it was clear that particular interest would attach to the spherical atmometer cup and to the filter

of next lower porosity, which proved to be the cylindrical atmometer A. After the standardization was carried out, as discussed later, bearing out the importance of the work with these 2 cups a second series of inoculations was made with new filtrates of diseased juice through these 2 cups. Twenty tobacco plants were inoculated with each filtrate and numerous uninoculated controls were kept in adjacent plats. Between 10 and 18 days after the inoculations 19 plants developed the disease among those inoculated with the spherical cup filtrate and 5 plants became diseased from the filtrate of the cylindrical cup A. Thus the previous test was admirably confirmed and even better indications were afforded that a small number of infected particles pass the cylindrical atmometer cup.

Standardization of the Filters

In attempting to standardize the filters which had been employed in this work there was the possibility of using the same filter after a thorough cleansing, or the possibility of employing a similar filter assumed to be of equal porosity. It became evident that direct standardization of the original filter employed was essential where this could be done without fear of change or injury. Consequently the first step in the standardization involved a thorough cleansing of the filters employed. The standardization process was delayed until after the results of the inoculation in order to limit the amount of unnecessary work. From the inoculation experiments it was clear that the sizes of the infective particles must lie between the pore sizes of the spherical atmometer cup used and that of the most porous cylindrical tube A, and probably close to the pore sizes of the latter. At the time we had no idea of the relation of these sizes, and had not the subsequent standardization experiments indicated that these two pore sizes were sufficiently close together, it would have been necessary to seek further for a porous filter of intermediate pore dimensions.

To avoid difficulties arising from adsorption or from the possible action of electrolytes derived from the filters, it was determined to use organic sols rather than metallic sols for

standardization purposes. It was, however, with some regret that the use of gold sols was then considered undesirable, since the sizes of the particles in such solutions have been so well determined. In undertaking the standardization work it seemed best to use at the outset colloidal solutions that might represent extremes in sizes and then to narrow the field down to those that might correspond more nearly with the particles of the mosaic disease. Accordingly, a solution of dextrin was first used, since the particles represent extreme smallness in colloidal solutions, and moreover the filtrates could be readily tested by the simple iodine method. Filtration experiments with a 1 per cent dextrin solution indicated that these particles passed freely through all of the standard unimpregnated porcelain cups employed. A small quantity of dextrin passed the cylindrical cup C, impregnated with $Al(OH)_3$, and none passed the other cup so impregnated.

In the next test milk free of fat was employed with a view to determining the size relation between the mosaic disease particles and casein in milk. The milk was first filtered through the spherical atmometer cup and it was found that this filter prevents entirely the passage of casein. The filtrate was a clear solution containing no demonstrable quantity of casein. It was now necessary to utilize a larger colloidal molecule for standardization than dextrin, and yet a molecule considerably smaller than casein in milk, thus hemoglobin was selected.

The hemoglobin employed was a preparation made by standard methods from ox blood. As soon as the ox blood was drawn neutral potassium oxalate to make 0.2 per cent was added in order to prevent clotting. A measured quantity of the blood was then distributed in centrifuge tubes and centrifuged, the supernatant serum being drawn off and the known volume of corpuscles thoroughly washed 4 times with a physiological salt solution (0.9 per cent NaCl). An equal volume of distilled water was added to lake the corpuscles, after which the solution was again centrifuged to remove fibrin and stroma. The red supernatant colloidal solution was finally diluted so as to contain 1 per cent hemoglobin, estimating the original hemoglobin blood content at 12 per cent. For this work it was not necessary,

of course, to dialyze or otherwise further purify the product, as was requisite in the type of studies pursued by Bottazzi ('13), Reichert ('09), and others.

For ultrafiltration work hemoglobin has been recognized as a product of exceptional value. By any standard method of preparation it would seem that the particles are of fairly uniform size, so much so that it was employed by Bechhold in standardizing and designating the porosity of his gelatin filters. Nevertheless, the actual sizes of the particles do not seem to have been determined. In one of his papers Bechhold ('07) indicates that the particles must average a little less than 20 μμ, being fairly comparable with "Kollargol (koll. Silber v. Heyden)". In his text ('19), moreover, the same author places them at smaller than the particles of 1 per cent gelatin and larger than serum albumen, which would indicate a measurement somewhat greater than 30 μμ. Later in the same work (p. 111) he indicates the sizes of hemoglobin particles at 33–36 μμ. The diameter of the hemoglobin molecule has been given as 2.3–2.5 μμ.

The tests with the standardized hemoglobin solution yielded results both satisfactory and illuminating. Through the Mandler filter with the usual time interval mentioned the filtrate was a very deep red, yielding no appreciable dilution of the hemoglobin. Through the spherical atmometer cup the filtrate was still very red, indicating that relatively few particles of the hemoglobin were held back. Through the cylindrical atmometer cup A there was a very slight passage of hemoglobin particles, while through the cylindrical tube B and both tubes impregnated with $Al(OH)_3$ there was no passage of hemoglobin particles whatsoever in these tests.

Further it may be of interest to state that the spherical atmometer cup referred to above permitted approximately 50 per cent of the gelatin particles to pass through the filter from a 1 per cent solution of gelatin. The amount passing through was determined colorimetrically in comparison with the original solution by means of the Biuret test. The gelatin solution was prepared by adding gelatin to the boiling water and then immediately cooling to room temperature.

DISCUSSION

From the results presented it would seem clear that with approximately equal pressures and equal time intervals the infective particles of the juice of tobacco plants affected with the mosaic disease possess about the same capacity to pass through the pores of porcelain filters as do the colloidal particles of fresh hemoglobin prepared by standard methods. No determinable dilution or loss of infectivity of the tobacco juice was occasioned by filtration through the spherical atmometer cup used in these experiments. On the other hand, a dilution of approximately 50 per cent resulted when a 1 per cent gelatin solution was filtered in the same cup. The sizes of the infective particles would therefore appear to be considerably less than those of gelatin particles, and since the particles of gelatin are not apparently very much larger than those of hemoglobin the conclusion is further strengthened that the infective particles here in question have about the size relations of fresh hemoglobin. In considering the estimated size of hemoglobin particles referred to previously in connection with the work of Bechhold it should be pointed out that Bechhold seems to have worked with dried preparations of hemoglobin, and it is perhaps to be expected that these would be larger rather than smaller than those of the fresh product. All indications are that, in general, a relatively freshly made colloidal solution possesses particles more uniform in size, and this idea is tentatively accepted. Assuming that at most the hemoglobin particles worked with may have possessed a diameter of 30$\mu\mu$, more or less, and that the average small diameter of bacterial plant pathogens is around 1000$\mu\mu$ (some being as low as 500 and others as large as 1500$\mu\mu$) we have 30: 1000 to express roughly the diameter relations of mosaic disease particles in comparison with bacterial plant pathogens. On the basis of this average relation it is interesting to note that the volume relation would be about as follows: 1: 37,000, or about 26: 1,000,000, assuming that in each case we may treat the bodies as spherical structures.

The results of the filtration experiments have directed the attention of the writers to the possibility of the existence of

minute organisms or propagative parts of organisms in the soil or in other products which are commonly the seat of varied bacterial activities. While this has been previously pursued in certain directions an investigation of one important aspect of the problem has been undertaken. This work will be reported upon in a subsequent paper.

No reference has thus far been made to two recent reports by Kunkel which are of particular interest in this connection. In the earlier paper Kunkel ('21) has studied cytologically the tissues of corn affected with a mosaic disease and he reports, describes, and figures a foreign body believed to be a living organism invariably present in the diseased cells. The distribution of this body is found to correspond with the distribution of the light green color areas in the diseased leaves. While no proof has been afforded that these bodies are etiologically related to the corn mosaic, or even that they are living structures, it is suggested that they may be more or less analogous to the Negri bodies in the brain cells of animals suffering from rabies. In a more recent note Kunkel ('22) has associated ameboid bodies with the *Hippeastrum* mosaic, this host plant being a member of the *Amaryllidaceae*. Analogous bodies have not thus far been mentioned by those who have studied the mosaic disease of tobacco histologically or cytologically.

It is of course not certain that the mosaic diseases of these monocotyledonous plants are caused by organisms or agencies similar to those inducing the mosaic of tobacco. At the present time either possibility may be entertained. Even should an ameboidal structure be found in the cells affected with mosaic disease of tobacco and etiologically associated therewith, interest in the filtration experiments would remain. Whatever might be the size relations of such an organism in the uninjured cell, its behavior under filtration would indicate that relatively minute colloidal particles of the body are capable of reproducing it. A discussion of theoretical aspects is reserved until further experimental work has been done.[1]

[1] Since the above was written the attention of the writers has been drawn to an article previously overlooked on a filterable virus, as follows: Andriewski, P. L'ultrafiltration et les microbes invisibles. Centralbl. f. Bakt. I. **75**: 90–93. 1914. Using

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the virus of the "peste des poules," this investigator compared the ultrafiltration of this disease agency with hemoglobin and serum albumin, all filtrations being made through a graded series of collodion membranes. It was determined that the particles of the virus were smaller than hemoglobin and about the size or somewhat smaller than serum albumin. In discussing actual sizes, however, he seems to confuse the sizes of colloidal particles of hemoglobin with the sizes of molecules. Nevertheless, his conclusion is to the effect that this virus cannot be formed of cells similar to those of plants and animals at present known.

TILLETIA TEXANA IN MISSOURI

H. R. ROSEN

Rufus J. Lackland Fellow in the Henry Shaw School of Botany of Washington University

While looking over smut collections in the herbarium of the Missouri Botanical Garden the writer came upon a collection on a wild grass, *Hordeum pusillum* Nutt., common in Missouri and in adjoining regions, which is of particular interest. This smut has apparently been reported only once before, from Texas, the type locality, and since the original description was based on but one collection a brief description of the Missouri material should be of some assistance in fixing the identity of this species as well as calling attention to a new host and a new locality.

This smut is of the covered type, the glumes remaining intact while the ovule is more or less completely replaced by the spore mass, and, like other smuts of the covered type, is apt to be overlooked. It was collected by C. H. Demetrio, near Emma, Saline County, Missouri, on June 20, 1896, and it is worth noting that while the host of the type collection is *Hordeum nodosum* L. (*H. pratense* Huds.) the collection under discussion is on *H. pusillum*.

Clinton's description of *Tilletia texana* Long (Jour. Myc. 8: 149. 1902), appearing also in the same author's monograph of the North American Ustilaginales, portrays well the collection at hand. The following additional notes may be of interest. The attacked ovules are considerably enlarged, often assuming two or three times the width of the normal kernels, and instead of appearing straw-colored they are of a grayish green external appearance. Internally they present an agglutinated light-reddish brown spore mass, as Clinton states. His description of the spores, including color, shape, markings, size, etc., might have been written for the Missouri material. I find the same characters that he describes. In addition it should be noted that the hyaline envelope is 2.5–3.5 μ thick and that many of

the spores show a small apiculus which at times is replaced by a slender thread-like, colorless hypha. This apiculus or slender thread simulates the aspects of a pedicel; at any rate, it is quite likely to be the point of attachment to the stromatic mass. Some of Lutman's figures (Trans. Wis. Acad. Sci. **16**: 1191–1244. 1910), depicting the manner in which resting spores are developed in some smuts, would indicate that some such method of attachment of spore to the stroma is not uncommon. May this be regarded as a step culminating in the development of a true pedicel such as numerous rusts possess?

In Clinton's description it will be noted that he is not certain of the maturity of his material, and particularly in connection with the light orange-yellow color of the spores, he says: "Appearing as if somewhat immature." The Missouri material shows the same color and in the mind of the writer there is little doubt of the maturity of this material. In this region *Hordeum pusillum*, the host, is one of the grasses which appears early and usually matures during May or the first half of June. By the end of June this grass begins to disappear and is gradually supplanted by later developing grasses. As Demetrio's collection was made on June 20, there is little doubt that the host as well as the fungus must have reached maturity. The fact that other smuts, closely related to this species, are also light-colored should leave little doubt on this matter.

The relationship of *Tilletia texana* to other species is worthy of consideration. Besides this species four others of the genus *Tilletia* have been described on various species of *Hordeum*. They are *T. Hordei* Körn., *T. Trabuti* Jacz., *T. Panicicii* Bub. & Ranojevic, and *T. Bornmülleri* Magn. Clinton has already called attention to the difference between *T. texana* and *T. Hordei*, namely, the reticulate markings of spores of the latter species. The other species likewise are said to have reticulate spores besides other diagnostic characters which are not possessed by *T. texana*. Indeed, species on other host genera show greater similarity to this smut. Besides *T. buchloena*, mentioned by Clinton, *T. Wilcoxiana* Griffiths and perhaps *T. Rauwenhoffii* Fisch. de Waldh. are closely related. *Tilletia Wilcoxiana* on *Stipa Hassei* in particular deserves attention. Besides the

characteristic hyaline membrane the spores of this smut also are light-colored as well as possessing other features in common with *T. texana*. The differences as noted in material in the herbarium of the Missouri Botanical Garden (collected by H. E. Hasse at Los Angeles, Cal., April 5, 1895) are in the smaller markings and in the somewhat smaller-sized spores of *T. Wilcoxiana*. Whether these differences denote unlike species or merely influences of unlike hosts on the same species is a question. Without a larger number of collections and without cross-inoculation experiments it would perhaps be best to consider them as two distinct species.

SOME NORTH AMERICAN TREMELLACEAE, DACRYOMYCETACEAE, AND AURICULARIACEAE

EDWARD ANGUS BURT

Mycologist and Librarian to the Missouri Botanical Garden
Professor of Botany in the Henry Shaw School of Botany of Washington University

In 1899 I compared the authentic specimens of tremellaceous fungi in the Schweinitz herbarium in Philadelphia with collections which I had accumulated while living in Vermont, where many of the Schweinitzian species are frequent. From time to time I have studied the types of species described by Berkeley and Curtis and by Peck and made comparisons with them. My deep interest in Professor Coker's recent work 'The Lower Basidiomycetes of North Carolina'[1] and in Mr. Lloyd's studies and comments on various species leads me to present the following notes:

TREMELLACEAE

Peziza concrescens Schw. and *Tremella reticulata* (Berk. & Curtis) Farl. are white species of *Tremella,* growing on the ground, of which the former is so soft that it may possibly be confused by collectors with the white plasmodium of a Myxomycete. This species has a long north and south range, for I have one specimen collected by Langlois in Louisiana, which Patouillard referred to *Tremella fuciformis;* the original collection was made by Schweinitz in North Carolina and again near Philadelphia, when its basidiomycetous nature was recognized and it was published as *Dacryomyces pellucidus* Schw. This species is the *Corticium tremellinum* Berk. & Ravenel, collected by Ravenel in Georgia and referred to by Farlow in Rhodora **10:** 10. 1908. My collection was made by a mountain roadside between Lake Dunmore and Silver Lake, Vermont, where several fructifications were growing up from the ground incrusting herbs. In cases where several herbs were near enough together so that a fructification was using them all as supports,

[1] Elisha Mitchell Scientif. Soc. Jour. **35**: 113–182. *pl. 23, 39–66.* 1920. Issued July 6, 1922.

the fructification sagged by its own weight into cup-shaped form in the space between the several supports. It was such a form which led Schweinitz to publish the original collection as a *Peziza*. When incrusting only two stems the fructification sagged between the supports in the form of a whitish pellucid membrane. By its dependence for support of its mass upon herbaceous stems and by absence of projecting self-supporting lobes, *Tremella concrescens* is distinguishable at sight from *T. reticulata*, which is also white and grows on the ground but stands up a self-supporting, coralloid mass with many short cylindric branches. *T. reticulata* has been frequently collected in the northern United States from Vermont westward to Minnesota but with southern limit the North Carolina station given by Coker.

Tremella fuciformis Berk. is the third species of the group. This is a tropical species ranging from Brazil through the West Indies into the southern United States as far north as North Carolina. It has been collected but few times and has always been found growing on wood. There has been a tendency to confuse both *T. reticulata* and *Dacryomyces pellucidus*, the synonym of *T. concrescens*, with *T. fuciformis* but the growth from the ground, not wood, seems a reliable means of distinction, although there are additional features of distinguishing *T. fuciformis* when it has to be determined in the herbarium from dried specimens not accompanied by notes as to substratum. *T. fuciformis* dries with the upper portions white and the basal portion in the region in and near the wood ochraceous tawny; it agrees with *T. reticulata* in being self-supporting and branched, but in dried condition main trunk, main branches, and final branches are not at all cylindric but flattened into leaf-like form with branches at the margins of the main trunk and main branches and all in a common plane although more or less crisped by the great number of ultimate branches. There are differences between these three species in microscopic characters which are given in the following more complete descriptions with synonymy, etc.

Tremella concrescens (Schw.) Burt, n. comb. Plate 3, fig. 1.

Peziza concrescens Schweinitz, Naturforsch. Ges. Leipzig

Schrift. **1**: 118. 1822; Am. Phil. Soc. Trans. N. S. **4**: 171. 1832; Fries, Syst. Myc. **2**: 53. 1823; Sacc. Syll. Fung. **8**: 76. 1889.—*Dacryomyces pellucidus* Schweinitz, Am. Phil. Soc. Trans. N. S. **4**: 186. 1832; Sacc. Syll. Fung. **6**: 804. 1888; Morgan, Cincinnati Soc. Nat. Hist. Jour. **11**: 94. 1888; Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 173. 1920.—*Corticium tremellinum* Berkeley & Ravenel, Grevillea **1**: 180. 1873; Sacc. Syll. Fung. **6**: 632. 1888; Massee, Linn. Soc. Bot. Jour. **27**: 146. 1890; Farlow, Rhodora **10**: 10. 1908.—An *Tremella vesicaria* of Lloyd, Myc. Writ. **5**. Myc. Notes 60: 871. *text f. 1486*. 1919? Not *Tremella vesicaria* Bulliard.

Type: in Herb. Schweinitz.

Fructifications gelatinous, very soft, growing up from the ground and ascending, incrusting and supported by herbaceous stems between which the masses are suspended in various forms determined by distribution of the supports, often a whitish, semi-pellucid membrane, drying hard, horn-like, somewhat wood-brown, and more or less veined; basidia longitudinally, cruciately septate, subglobose, 12–15×10–12 μ; spores hyaline, even, 8–9×4½–6 μ.

Fructifications 2–6 cm. high and broad.

On the ground by roadsides in woods, growing up and concrescent with stems of plants and other parts. Vermont to Louisiana and in Missouri. July and August. Rare.

This species is characterized by its occurrence on the ground from which it rises by support of small stems and other objects, absence of branches of characteristic form, rather large, subglobose basidia, and the small spores. Lloyd's figure which I have cited does not show the usual aspect of fructifications of this species. The form C noted by Gilbert, Wis. Acad. Trans. **16**: 1153. *pl. 83. f. 22*. 1910, seems to be *T. concrescens*.

Specimens examined:

Vermont: near Lake Dunmore, *E. A. Burt.*

Pennsylvania: near Philadelphia, *Schweinitz*, type of *Dacryomyces pellucidus* (in Herb. Schweinitz).

North Carolina: *Schweinitz*, type (in Herb. Schweinitz).

Georgia: Cotoosa Springs, *Ravenel, 1754*, type of *Corticium tremellinum* (in Curtis Herb.).

Alabama: *Peters, 897* (in Curtis Herb.).
Louisiana: *A. B. Langlois, 2973;* St. Martinville, *A. B. Langlois, 2087,* under the herbarium name *Sebacina tremellosa* E. & E.
Missouri: St. Louis, *N. M. Glatfelter, 229* (in Mo. Bot. Gard. Herb., 57674).

T. reticulata (Berk.) Farlow, Rhodora **10**: 9. Ja. 1908; Gilbert, Wis. Acad. Trans. **16**: 1152. *pl. 83. f. 17–21.* 1910; Sacc. Syll. Fung. **21**: 455. 1912; Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 139. *pl. 37; pl. 56. f. 12.* 1920.

Corticium tremellinum var. *reticulatum* Berk. Grevillea **1**: 180. 1873; Sacc. Syll. Fung. **6**: 632. 1888; Massee, Linn. Soc. Bot. Jour. **27**: 146. 1890.—*C. reticulatum* Berk. & Curtis in Cooke, Grevillea **20**: 13. 1891.—*Tremella Clavarioides* Lloyd, Myc. Writ. **3**. Myc. Notes, Old Species 1: 10. *text f. 224.* Ju. 1908.—*T. Sparassoidea* Lloyd, Myc. Writ. **6**. Myc. Notes 61: 894. *pl. 135. f. 1562.* 1920, and Myc. Notes 62: *pl. 145. f. 1646.* 1920; Overholts, Mycologia **12**: 141. *pl. 10. f. 3.* 1920.—*T. fuciformis* Atkinson, Mushrooms, 206. *text f. 207,* but not *T. fuciformis* Berk.

Illustrations: Atkinson, Coker, Gilbert, Lloyd, and Overholts, *loc. cit.*

Type: in Curtis Herb.

Fructifications gelatinous, rather firm, elastic, white, growing up from the ground in erect, branched, self-supporting tufts which are more or less fused together and anastomosing, with all parts usually hollow, finally becoming somewhat cinnamon-brown in the herbarium; branches somewhat cylindric, short, projecting, obtuse; basidia 12×8–9 μ; spores hyaline, even, 6–10×4½–6 μ, as found in preparations of the hymenium.

Fructifications 2½–8 cm. high, 3½–10 cm. in diameter.

Growing on the ground in woods, Vermont to North Carolina and westward to Wisconsin. July to October.

Tremella reticulata is distinguished by its rising from the ground as a white, self-supporting, coralloid mass so firm and elastic that it can be bent, twisted, or compressed and the parts spring back into their original position.

Specimens examined:

Vermont: Grand View Mt., *E. A. Burt;* Middlebury, *E. A. Burt.*
Pennsylvania: comm. by C. H. Peck under the name *T. vesicaria; Michener, 1212,* type of *Corticium tremellinum* var. *reticulatum,* (in Curtis Herb., 3942).
Minnesota: Minneapolis, *M. L. Whetstone,* comm. by F. Weiss, type of *T. Sparassoidea* (in Mo. Bot. Gard. Herb., 56256).

T. fuciformis Berkeley, Hooker's Jour. Bot. **8**: 277. 1856; Linn. Soc. Bot. Jour. **10**: 340. 1868; Sacc. Syll. Fung. **6**: 782. 1888; A. Möller, Bot. Mitt. a. d. Tropen **8**: 115. *pl. 1. f. 5; pl. 4. f. 13.* 1895; Farlow, Rhodora **10**: 11. 1908; Lloyd, Myc. Writ. **5**. Myc. Notes 55: 790. *text f. 1188.* 1918; Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 140. *pl. 38, 56. f. 7.* 1920.

Illustrations: as given above and Engl. & Prantl, Nat. Pflanzenfam. (**I**:1**): 93. *text f. 60 H.*

Type: probably in Kew Herb.

Fructifications solitary or cespitose, gelatinous, rather tough, erect, white, repeatedly lobed or forked, with the peripheral lobes thin, flat, much crinkled or fluted, drying with the upper portion white and basal portion ochraceous tawny; basidia subglobose, 7–10×6–7½ μ; spores hyaline, even, 5–6×4–4½ μ, as found in a preparation of the hymenium.

Mass of fructifications about 2 cm. high and 3–5 cm. in diameter in northern specimens, attaining larger size in Brazil.

On dead wood. North Carolina, West Indies, and Brazil. October to January.

Tremella fuciformis occurs on wood in a rosette-like mass of thin, crinkled, and fluted lobes, white and drying white except in the region of attachment to the wood where the color is ochraceous tawny; the basidia and spores are subglobose and small.

Specimens examined:
Cuba: *C. Wright, 233* (in Curtis Herb.).
Porto Rico: Bayamon, *J. A. Stevenson, 6765* (in Mo. Bot. Gard. Herb., 55055).

Other white species of tremellaceous fungi occurring on a wood substratum are *Exidia alba* and *E. candida. E. alba* is frequent in the middle west from Wisconsin southward to Ala-

bama along the northern range of *Tremella fuciformis*. *E. alba* was formerly confused with *E. albida* of Europe until Lloyd pointed out that the former is clearly distinct from any known white tremelline species of Europe by the presence of gloeocystidia in its hymenium. Lloyd included *E. alba* in the little-known Australian genus *Seismosarca* but I am reluctant to follow him in this respect, for since genera are merely rather natural groups of species of convenient size for taxonomic work, it seems unnecessary and a great pity to segregate already small genera on the basis of every positive character which would make a species noteworthy. *E. candida* is known so far from the state of Washington only.

The details of the above species are as follows:

Exidia alba (Lloyd) Burt, n. comb.

Exidiopsis alba Lloyd, Myc. Writ. **4**. Letter 44:8. 1913.—*Seismosarca alba* Lloyd, Myc. Writ. **5**. Myc. Notes 45: 629. 1917; Myc. Writ. **6**. Myc. Notes 65: 1045. *f. 1928, 1929*. 1921.

Fructifications large, cerebriform, subfoliaceous or with rounded convolutions, white or somewhat creamy, marginal portions discoloring in the herbarium to tawny olive and Sayal-brown and the more central regions approaching fuscous; gloeocystidia somewhat colored, cylindric, flexuous, up to 30×6 μ; basidia subglobose, 10×9 μ; spores hyaline, curved, even, 9–10×4½ μ; edible.

Fructifications 1–4 cm. high, 2–10 cm. in diameter.

On dead wood. According to literature probably ranging from New York to Minnesota and southward to Alabama but known to me by specimens from Wisconsin to Alabama only. June to October. Frequent.

Within the basin of the Mississippi *E. alba* is the common species occurring in large, white or slightly creamy masses on dead wood; reference of collections to this species may be confirmed by presence of the conspicuous gloeocystidia when a bit of the hymenium is crushed in water under a cover glass. Dr. Glatfelter found this species so abundant in Forest Park, St. Louis, that he tested its edible properties, and he noted on the collection which was preserved that this species is "edible but not delicious."

Specimens examined:
Wisconsin: Blue Mounds, *E. T. & S. A. Harper, 868.*
Missouri: Creve Coeur, *L. O. Overholts* (in Mo. Bot. Gard. Herb., 57678); St. Louis, *N. M. Glatfelter, 49* (in Mo. Bot. Gard. Herb., 57677).
Alabama: Montgomery, *R. P. Burke, 78* (in Mo. Bot. Gard. Herb., 13540).

E. candida Lloyd, Myc. Writ. 5. Myc. Notes 44: 620. *text f. 880, 881.* 1917.

Fructifications effused, somewhat pulvinate, with the surface tuberculate and having irregular folds, white or grayish, discoloring to bister in the herbarium when dry, and cracking and curling up from the substratum; basidia 12–15×10 μ; spores hyaline, even, 12–13×4–4½ μ, stated by Lloyd to be 16×8 μ; no gloeocystidia.

Fructification 2–5 mm. thick, spread out over areas 10 cm. and more in diameter.

On rotten *Corylus.* Washington. August.

This species is noteworthy by its broadly effused and relatively thin fructifications and spores at least twice as long as broad.

Specimens examined:
Washington: Bingen, *W. N. Suksdorf, 751.*

In December, 1899, I studied the specimen of *Tremella aurantia* Schw. in Herb. Schweinitz in Philadelphia, before it had been examined by either Lloyd or Coker. I noted that it was on an oak limb which was also bearing *Stereum rameale.* The preparation which I have of a bit of the hymenium of this authentic specimen still shows the longitudinally cruciately septate basidia and subglobose, hyaline, even spores about 10×8 μ. These dimensions do not exclude *Tremella mesenterica,* but the form and general aspect of the fructification and its less brittle structure made me regard *T. aurantia* as a species distinct from the latter. In the following March I received from Professor P. H. Rolfs, then of Clemson College, South Carolina, a fine specimen from that region which measured 4½ ×3×2½ cm. high when fresh. This specimen agreed in all respects with my notes, preparations, and remembrance of the

authentic *T. aurantia* in Herb. Schweinitz and with the original description of this species which was based on specimens collected at Salem, North Carolina. Later in the year Professor Rolfs sent me another gathering of *T. aurantia*. These specimens from Professor Rolfs upon being split open proved to be white and fibrous-fleshy within, being cogeneric in this respect with *Naematelia encephala*, and they show this structure well at the present time, hence *Tremella aurantia* should be transferred to *Naematelia*. Coker has made this disposition of the species but under the name *Naematelia quercina* Coker. The descriptions and synonymy of this species and of the related *N. encephala* follow:

Naematelia aurantia (Schw.) Burt, n. comb.

Tremella aurantia Schweinitz, Naturforsch. Ges. Leipzig Schrift. **1:** 114. 1822; Am. Phil. Soc. Trans. N. S. **4:** 185. 1832; Fries, Syst. Myc. **2:** 213. 1823; Epicr. 588. 1838; Sacc. Syll. Fung. **6:** 781. 1888; Lloyd, Myc. Writ. **3.** Myc. Notes, Old Species 1: 11, with *text f 225* doubtful. 1908.—*Naematelia quercina* Coker, Elisha Mitchell Scientific Soc. Jour. **6.** 135. *pl. 23, f. 1; pl. 58, f. 1–2.* 1920; Lloyd, Myc. Writ. **35:** Myc. Notes 64: 1024. 1921.—An *Sparassis tremelloides* Berkeley, Grevillea **2:** 6. 1873? See Lloyd, Myc. Writ. **6.** Myc. Notes 64: 1025. 1921.—Not *Tremella aurantia* of Farlow, Appalachia **3:** 248. 1883, nor of Coker, Elisha Mitchell Scientif. Soc. Jour. **35:** 163. 1920.

Illustrations: Coker, *loc. cit.*

Fructifications a hemispherical or more elongated, cockscomb-shaped mass divided nearly to the substratum into a few—about 3–6—somewhat flattened and crumpled lobes, xanthine-orange (aurantiacus of Saccardo's 'Chromotaxia'), drying ochraceous orange to walnut-brown in the herbarium, and solid, fibrous, and whitish within when dried; basidia subglobose, longitudinally cruciately septate, 15–18 × 12–15 μ, often about 15 μ in diameter; spores hyaline, even, subglobose, 9–12 × 8–9 μ.

Fructifications when fresh up to 2½ cm. high by 4½ × 3 cm., contracting when drying to masses 5–7 mm. high by 12–16 × 6–12 mm.

On dead wood of frondose species. New Jersey to South Carolina. December to March. Rare.

Coker has published that the color is orange-yellow inside and out except for a thin white membrane about 0.7 mm. from the surface which follows all the convolutions and gives a marbled appearance to the cut surface. In the three gatherings before me which have been kept in the herbarium 20 to 25 years, the whole interior is as whitish within in its dried condition as it is in *Naematelia encephala* from which *N. aurantia* is distinguished in aspect by its larger, orange-colored fructifications which are divided nearly to the substratum into a few large lobes and by its occurrence on dead wood and dead saplings of oak and other frondose species.

Specimens examined:

Exsiccati: Ell. & Ev., N. Am. Fungi, 1719, under the name *Naematelia encephala*—three of the fructifications comprising the specimen in Mo. Bot. Gard. Herb. copy are *N. aurantia* and the fourth is *Tremella mesenterica;* Ell. & Ev., Fungi Col. 1118, under the name *N. encephala.*

New Jersey: Newfield, *J. B. Ellis,* in Ell. & Ev., N. Am. Fungi, 1719, and Fungi Col., 1118.

North Carolina: *Schweinitz,* type (in Herb. Schweinitz).

South Carolina: Clemson College, *P. H. Rolfs, 3, 1888.*

N. encephala (Willd.) Fries, Obs. Myc. **2:** 370. 1818; Syst. Myc. **2:** 227. 1823; Epicr. 591. 1838; Hym. Eur. 696. 1874; Berkeley, Outl. Brit. Fung. 290. 1860; Sacc. Syll. Fung. **6:** 793. 1888.

Tremella encephaliformis Willdenow, Bot. Mag. **2:** 17. *pl. 4. f. 14.* 1788.—*Naematelia encephaliformis* (Willd.) Coker, Elisha Mitchell Scientif. Soc. Jour. **35:** 137. 1920.—*Tremella encephala* (Willd.) Persoon, Syn. Fung. 623. 1801; Myc. Eur. **1:** 98. 1822; Engl. & Prantl, Nat. Pflanzenfam. (I: 1**): 94. 1897.

Illustrations: Willdenow, *loc. cit.;* Stevenson, Brit. Hym. **2:** 316. *text f. 99.* 1886; Smith, Brit. Basidiomycetes, 452. *text f. 117.* 1908; Brefeld, Untersuch. Myk. **7:** *pl. 8. f. 20.* 1888.

Fructifications solitary or clustered, nearly sessile, pulvinate, plicate-rugose, solid, drying cinnamon to Natal-brown externally and white and fibrous within; basidia 12–15 μ in diameter; spores hyaline, even, subglobose, 8–10 × 7–9 μ.

Dried fructifications 3–10 mm. in diameter, 3–5 mm. high.

On dead, fallen branches of coniferous species. Ontario to North Carolina. August. Rare.

Naematelia encephala has small fructifications which are nearly subglobose, scarcely more than rugose on the surface and not deeply divided; attachment to the substratum is usually by a point rather than by a broad resupinate surface; the substratum is pine or spruce in all specimens known to me.

Specimens examined:

Exsiccati: Berkeley, Brit. Fungi, 291; Krieger, Fungi Sax., 1008; Sydow, Myc. Germ., 58.

England: Berkeley, Brit. Fungi, 291.

Germany: Saxony, *H. & P. Sydow*, in Sydow, Myc. Germ., 58; Winterberge, *G. Wagner*, in Krieger, Fungi Sax., 1008.

Canada: Ontario, Temagami, *H. von Schrenk* (in Mo. Bot. Gard. Herb., 57052).

New Hampshire: Tuckerman's Ravine, *W. G. Farlow* (in Mo. Bot. Gard. Herb., 5352).

Vermont: Middlebury, *E. A. Burt.*

Under the name *Tremella nucleata* Schweinitz described a species of quite different structure from *Naematelia encephala* and *N. aurantia* Fries transferred this species to *Naematelia* because dried specimens contain scattered, white, spherical or lens-shaped calcareous masses imbedded in the fructification. These masses were termed nuclei by Fries but they are not of organic nature, being merely concretions[1] of calcium oxalate present in the gelatinous fructification and quite different from the white fibrous structure which forms the interior of *N. aurantia* and *N. encephala.* Some species of *Exidia* contain calcareous masses similar to those of *T. nucleata,* and since the spores of the latter are of the elongated form by which in herbarium work we distinguish *Exidia* from *Tremella,* I transfer this species to *Exidia,* as follows:

[1] Topin, Rev. Myc. **25**: 134. *pl. 233. f. 21.* 1903.

Exidia nucleata (Schw.) Burt, n. comb.

Tremella nucleata Schweinitz, Naturforsch. Ges. Leipzig Schrift. **1**: 115. 1822.—*Naematelia nucleata* (Schw.) Fries, Epicr. 592. 1838; Hym. Eur. 696. 1874; Berkeley, Outl. Brit. Fung. 290. 1860; Peck, N. Y. State Mus. Rept. **24**: 83. 1872; Berkeley & Curtis, Grevillea **2**: 20. 1873; Morgan, Cincinnati Soc. Nat. Hist. Jour. **11**: 93. 1888; Sacc. Syll. Fung. **6**: 793. 1888; Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 136. *pl. 23. f. 3; pl. 41. f. 1; pl. 56. f. 3–5.* 1920.—An *Exidia gemmata* (Lév.)?

Illustrations: Coker, *loc. cit.*

Type: in Herb. Schweinitz.

Fructification effused, plane, somewhat gyrose and undulate, white at first, shrinking to a membrane in drying and becoming tawny olive to mummy-brown and containing a few scattered, conspicuous, white, subglobose concretions of calcium oxalate about 1/5–1/3 mm. in diameter; basidia 8–12 × 6–8 μ; spores hyaline, even, curved, 8–9 × 3–4 μ.

Covering areas 5 mm.–3 cm. in diameter, not thicker when dry than the imbedded concretions.

On fallen limbs of frondose species. Maine to Louisiana and westward to California; occurs also in Europe. September to March. Widely distributed but not common.

Exidia nucleata is noteworthy by fructifications so thin that they suggest a *Sebacina* but are gelatinous throughout and often elevated or pinched up in the center, by the tawny olive color assumed in drying, and by the more or less numerous, white, chalky, seed-shaped concretions. I know *Exidia gemmata* of Europe only by the specimen received under this name from Bourdot; this specimen agrees in all respects with our *E. nucleata.*

Specimens examined:

Exsiccati: Ellis, N. Am. Fungi, 520; Ravenel, Fungi Car. **4**: 82.

France: Allier, St. Priest, *H. Bourdot, 12147.*

Maine: Orono, *F. L. Harvey* (in Mo. Bot. Gard. Herb., 1733, 5353).

Vermont: Middlebury, *E. A. Burt.*

New Jersey: *J. B. Ellis*, in Ellis, N. Am. Fungi, 520.

North Carolina: *Schweinitz*, type (in Curtis Herb.).
Alabama: *Peters*, in Ravenel, Fungi Car. **4**: 82.
Louisiana: St. Martinville, *A. B. Langlois, by.*
Michigan: Ann Arbor, *C. H. Kauffman* (in Mo. Bot. Gard. Herb., 58674).
California: Santa Catalina Island, *L. W. Nuttall, 524, 1012*, comm. by Field Mus. Nat. Hist. Herb. (in Mo. Bot. Gard. Herb., 57624, 57683).

Another Schweinitzian species is also noteworthy by containing more or less numerous, small, white, chalky concretions although not so noted by Schweinitz. This is his *Exidia spiculata*, a species of which I made gatherings in Vermont on rotting willow and other frondose species, growing from cracks in the bark.

E. spiculata Schweinitz, Am. Phil. Soc. Trans. N. S. **4**: 185. 1832; Sacc. Syll. Fung. **6**: 776. 1888; Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 151. 1920.

Type: in Herb. Schweinitz.

Growing out from cracks in the bark in elongated masses, with crumpled, rugose surface, about 3 mm. high, 2–4 mm. wide, 10–12 mm. long, between sepia and clove-brown when wet, shrinking when dried to a thin, fuscous-black membrane with veined and wrinkled surface and now showing white, seed-like concretions $^1/_5$–$^1/_2$ mm. in diameter; basidia 9 × 6 μ; spores simple, hyaline, curved, 9–10 × 4 μ.

On bark of fallen, decaying limbs of *Salix*, *Betula*, etc. Vermont to Pennsylvania. September to March.

E. spiculata and *E. nucleata* differ from other species of *Exidia* by containing small, whitish, seed-like concretions. *E. spiculata* is darker-colored than *E. nucleata*, much thicker, and with a crumpled surface. The surface was described by Schweinitz as papillate; perhaps he used the term in a broad way, for I fail to find true papillae either on the surface of the specimen in Herb. Schweinitz or of my collections.

Specimens examined:
Vermont: Lake Dunmore, *E. A. Burt*, two collections; Middlebury, *E. A. Burt*, two collections.
New York: Altamont, *E. A. Burt.*

Pennsylvania: Bethlehem, *Schweinitz*, type (in Herb. Schweinitz).

Tremella colorata Peck, N. Y. State Mus. Rept. **25**: 83. 1873; Sacc. Syll. Fung. **6**: 788. 1888.

I have not collected this species but the color reactions of the type are so remarkable that, if constant, they should distinguish the species from all others known to me. In the first place the ash bark and wood for a distance about the fructification are now, fifty years since the collection was made, still conspicuously stained vinaceous-drab as noted by Peck. Furthermore, in my microscopical, glycerin mount of this fungus, stained with Gruebler's alcoholic eosin and the color set with a trace of acetic acid, the basidia and hyphae are vinaceous-lilac instead of the brighter red usually given by the eosin. The basidia are spherical, 13–15 μ in diameter, longitudinally cruciately septate, mostly still immature although occasionally one may be found bearing slender sterigmata up to 30 μ long; only four spore-like bodies have been found; all are hyaline, simple, even, curved, two are 7 × 4½ μ and the other two 15 × 6 μ. It seems improbable that the spores are colored, globose, 12–15 μ in diameter, as published by Peck. Should an *Exidia* be collected having color characters and basidia as noted, comparison with the type as to other characters will probably demonstrate that it is *T. colorata* Pk.

Tremella subcarnosa Peck, N. Y. State Mus. Rept. **32**: 36. 1879; N. Y. State Mus. Bul. **1**[2]: 15. 1887; Sacc. Syll. Fung. **9**: 258. 1891.

Examination of the type in N. Y. State Mus. Herb. shows that this fungus is not a Basidiomycete but rather one of the *Tuberculariеae*.

So many species of *Tremellaceae* had been published as species of *Thelephora*, *Stereum*, and *Corticium* and were distributed under these genera in herbaria that I have already published[1] for the convenience of students of the *Thelephoraceae* an account of the central-stemmed tremelloid genus *Tremellodendron*, the reflexed *Eichleriella*, and the resupinate *Sebacina*.

[1] Mo. Bot. Gard. Ann. **2**: 731–770. 1915.

We have a few species of tremellaceous fungi which are hydnoid in general aspect and belong in *Heterochaete*, a genus defined as follows:

HETEROCHAETE Patouillard, a genus of resupinate tremellaceous fungi whose species have the general aspect of species of *Odontia* with cystidia clustered in the granules and with the basidia longitudinally cruciately septate. Our North American species are *H. andina*, *H. gelatinosa*, *H. sublivida*, *H. microspora*, and *H. Shearii*—none of which are known from north of District of Columbia.

Heterochaete andina Patouillard & Lagerheim, Soc. Myc. Fr. Bul. **8**: 120. *pl. 11. f. 2.* 1892; Sacc. Syll. Fung. **11**: 144. 1895.

Illustrations: Patouillard, *loc. cit.*

Fructifications resupinate, effused, thin, adnate, drying cartridge-buff, with margin whitish, the surface bearing numerous small, sharp-pointed granules; in structure 60–75 μ thick, composed mostly of densely interwoven, hyaline hyphae of uneven outline, 2½–3 μ in diameter, sometimes with hyphae slightly colored next to substratum; granules cylindric, 1201–50 μ high, 40–60 μ in diameter, containing an axile cluster of slightly colored or sometimes hyaline, granule-incrusted hyphae 3 μ in diameter which spread apart at the apex; basidia longitudinally septate, 12–16 × 6–9 μ; spores hyaline, even, curved, 12–14 × 4–7 μ.

On dead fallen branches of frondose species. Florida, Louisiana, and West Indies to Ecuador. November to April.

Heterochaete andina has the aspect of a nearly white *Odontia* or resupinate *Hydnum*, from both of which it is distinguished by the longitudinally cruciately septate basidia. One of the Louisiana specimens cited below is from a gathering which was determined by Patouillard for Langlois as *H. andina.*

Specimens examined:

Florida: Cocoanut Grove, *R. Thaxter, 93* (in Mo. Bot. Gard. Herb., 43920, and in Farlow Herb.).

Louisiana: Baton Rouge, *Humphrey & Edgerton*, comm. by C. J. Humphrey, 5710 (in Mo. Bot. Gard. Herb., 9982); St. Martinville, *A. B. Langlois, 2855, 2988,* and *ah.*

Porto Rico: Bayamon, *J. A. Stevenson, 6303* (in Mo. Bot. Gard Herb., 55085).

Mexico: Orizaba, *W. A. & E. L. Murrill, 798* and *749 b* (in Mo. Bot. Gard. Herb., 54614 and 54653, and in N. Y. Bot. Gard. Herb.).

H. sublivida Patouillard, Soc. Myc. Fr. Bul. **24**: 2. 1908; Sacc. Syll. Fung. **21**: 449. 1912.

H. Burtii Bresadola, Ann. Myc. **18**: 51. 1920.

Fructifications resupinate, adnate, broadly effused, thin, drab-gray to light drab, the margin of the same color or paler; hymenium bearing more or less numerous granules or papillae with whitish tips; in structure 100–200 μ thick, composed of interwoven hyaline hyphae 2–2½ μ in diameter, and some masses of crystalline matter; granules 200–300 μ high by 100 μ in diameter at the base, composed of a few hyphae and much crystalline matter in masses; basidia longitudinally septate, 16–20 × 8–10 μ; spores white in collection on slide, flattened on one side, 8–10 × 5–6 μ.

Covering areas 6 cm. and more long, 3 cm. and more wide.

On bark of decaying frondose wood. Louisiana and the West Indies. October to March.

This species has been confused in American mycology with *Grandinia ocellata*, from which it is distinct by its longitudinally septate basidia; it may be easily separated from our other species of *Heterochaete* by its livid (drab of Ridgway) color. Nearly twenty years ago I shared with Bresadola a specimen of this fungus received from Langlois. The interruption to correspondence by the war prevented my calling Bresadola's attention to the fact that a portion of another gathering, communicated by Langlois to Patouillard, was published by the latter as a new species, hence the synonymy.

Specimens examined:

Louisiana: St. Martinville, *A. B. Langlois, 2882*, cotype of *H. sublivida*, *bk*, cotype of *H. Burtii*, and *at*

Cuba: El Yunque Mt., Baracoa, *L. M. Underwood & F. S. Earle, 371*, N. Y. Bot. Gard., Fungi of Cuba.

Porto Rico: Campo Alegre, *J. A. Stevenson, 6370* (in Mo. Bot. Gard. Herb., 55658).

H. gelatinosa (Berk. & Curtis) Patouillard, Soc. Myc. Fr. Bul. **8**: 120. 1892; Sacc. Syll. Fung. **11**: 144. 1895; Lloyd, Myc. Writ. **5**. Myc. Notes 59: 857. *text f. 1439.* 1919.

Kneiffia gelatinosa Berkeley & Curtis, Linn. Soc. Bot. Jour. **10**: 327. 1868; Sacc. Syll. Fung. **6**: 510. 1888.

Illustrations: Lloyd, *loc. cit.*

Type: in Kew Herb. and Curtis Herb.

Fructifications resupinate, effused, gelatinous, adnate, loosening from the substratum about the margin in drying, pallid at first, now pale smoke-gray, bearing granules about 9 to the mm.; in structure 500–800 μ thick, composed of densely interwoven and crowded, suberect, gelatinous-walled, hyaline hyphae 3 μ in diameter; granules about 100 μ high, about 50 μ in diameter at the base, containing an axile sheath of fine hyphae and an accumulation of crystalline matter; basidia longitudinally septate, 15 × 12 μ; spores hyaline, even, flattened on one side, 6–7½ × 4–5 μ.

Covers an area on bark of 5 × 4 cm., fractured on one side and one end.

Under side of rotten logs. Cuba. January.

Heterochaete gelatinosa is much thicker and more gelatinous than our other American species and has smaller spores than *H. andina* and *H. sublivida.* Its fructifications are so large and thick that it should attract notice of collectors but it would probably be classed as one of the *Hydnaceae* although it must be notably gelatinous.

Specimens examined.

Cuba: *C. Wright, 230,* type (in Curtis Herb.).

H. microspora Burt, n. sp.

Type: in Mo. Bot. Gard. Herb. and N. Y. Bot. Gard. Herb.

Fructifications resupinate, effused, at first a white floccose mycelium which persists later as a subiculum and bears on its surface a thin, waxy, hymenial layer, pinkish buff in the herbarium, more or less cracked, and showing through the cracks the filaments of the subiculum; in structure 100–150 μ thick,

Fig. 1. *H. microspora*. Section of fructification × 92; *b*, basidium, and *s*, spores, × 665.

composed of hyaline, even, thin-walled hyphae 2 μ in diameter, very loosely interwoven next to the substratum and with occasional crystalline masses 6–12 μ in diameter; granules minute, numerous, protruding 60–90 μ, containing an axile sheaf of slightly brownish hyphae and some incrusting granules; basidia longitudinally septate, 10–15 × 6–12 μ; spores hyaline, even, flattened on one side, 5–5½ × 3½–4 μ.

The portions of fructifications received cover areas up to 4 × 2 cm.

On decorticated, decaying, coniferous wood. Mexico. January.

Heterochaete microspora is distinguished by its floccose subiculum and thin hymenial layer, small spores, and occurrence on a coniferous substratum.

Specimens examined:

Mexico: Motzorongo, near Cordoba, *W. A. & E. L. Murrill, 990*, type, and *995* (in Mo. Bot. Gard. Herb., 54617 and 54618 respectively, and in N. Y. Bot. Gard. Herb.).

H. Sheari Burt, n. comb.

Sebacina Sheari Burt, Mo. Bot. Gard. Ann. **2**: 758. *text f. 2.* 1915.

Type: in Burt Herb. and in Shear Herb.

Fructifications resupinate, effused, adnate, coriaceous, with minute granules or papillae, dull white, drying pale olive-buff, cracked, the margin determinate, entire; in structure 110–140 μ thick, with (1) a dense layer next to the substratum of longitudinally arranged, slightly brownish, even-walled hyphae 1½–2 μ in diameter, which branch and curve outward at a right angle and form (2) a fertile less compact layer 60–90 μ thick, of suberect, flexuous paraphyses 3 μ in diameter, of basidia about 15–20 μ below the surface, and of flexuous, cylindric-clavate gloeocystidia 40–45 × 6 μ, not emergent above the surface; granules protruding 50–150 μ, of about the same diameter at

the base, and containing an axile sheaf of brownish hyphae coming from the layer next the substratum; basidia longitudinally septate, 15 × 9 μ; spores hyaline, even, simple, curved, 9–15 × 4½–6 μ.

Fructifications finally covering areas 7 cm. and more long, 1–2 cm. broad.

On dead *Berberis vulgaris* and other frondose limbs. District of Columbia and Island of Guam. October and March.

This species is noteworthy by its gloeocystidia. In the former description of this species under *Sebacina*, based on a gathering on *Berberis* in grounds U. S. Department of Agriculture, Washington, in 1902, I noted the presence of some granules on the hymenial surface. These granules are numerous in the specimen collected in 1819 on the Island of Guam, and by their structure in both gatherings require transfer of this species to *Heterochaete*. Since the only North American station is on the grounds of the United States Department of Agriculture, it seems probable that *H. Sheari* is an introduced species in our American flora coming from Guam or other distant lands of the Pacific.

Specimens examined:

District of Columbia: grounds U. S. Dept. Agr., Washington, *C. L. Shear, 1238*, type.

Island of Guam: *Edwards*, comm. by J. R. Weir, 10778 (in Mo. Bot. Gard. Herb., 56240).

DACRYOMYCETACEAE

Under the name *Tremella palmata*, Schweinitz described the commonest *Dacryomyces* of New England, southern Canada, and northern United States. This species ranges south to Louisiana and westward to Washington and north to Alaska. I have a single gathering on *Betula lutea* but other specimens known to me are on rotting coniferous wood. *D. palmatus* may occur as solitary or gregarious fructifications, with the lower portion tapering downward as in the authentic specimen in Schweinitz Herbarium and the illustrations by Coker and by Lloyd cited on a following page, or it may more usually and when better developed be a large, bright orange-yellow cluster of probably many fructifications so intimately coalescent as to

appear a single, many-lobed mass with no differentiated base as in the illustration in Coker's pl. 48.

Dacryomyces palmatus (Schw.) Burt, n. comb. Plate 3, fig. 2.

Tremella palmata Schweinitz, Am. Phil. Soc. Trans. N. S. **4**: 186. 1832; Sacc. Syll. Fung. **6**: 782. 1888; Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 151. 1920.—*Dacryopsis palmata* (Schw.) Lloyd, Myc. Writ. **6**. Myc. Notes 64: 989. *pl. 159. f. 1762.* 1921.—*Dacryomyces chrysosperma* Berk. & Curtis, Grevillea **2**: 20. 1873; Sacc. Syll. Fung. **6**: 801. 1888.—*D. aurantius* Farlow, Appalachia **3**: 248. 1883; Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 163. *pl. 23. f. 10; pl. 48; pl. 63. f. 6, 7.* 1920.—An *Dacryomyces flabellum* Ellis & Everhart, Acad. Nat. Sci. Phila. Proc. **1894**: 324. 1894?

Illustrations: Coker, *loc. cit.;* Lloyd, *loc. cit.;* Gilbert, Wis. Acad. Trans. **16**: 1156. *pl. 83. f. 25, 26.* 1910.

Type: in Herb. Schweinitz.

Fructifications gregarious or cespitose and forming erect, gelatinous, rounded, brain-like, complicated masses with surface lobed and folded, slimy when wet, cadmium-yellow to ochraceous orange and drying the same color, penetrating the bark by a whitish, radicated base; basidia forked; spores colored like the fructification, curved, becoming 5–7-septate, 18–28 × 6–7μ.

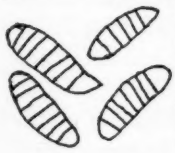


Fig. 2. *D. palmatus.* Spores of type × 665.

Mass fructifications up to 2 cm. high, 1–2 cm. broad, and 1–5 cm. long.

On coniferous stumps, logs, and brush. Canada to Louisiana and westward to British Columbia and Washington. July to March. Common in New England.

Dacryomyces palmatus is distinguished by its large size, bright orange-yellow color, and large 8-celled spores. Old mass forms attain the size of a large *Tremella;* some specimens of this species were distributed from Schweinitz's herbarium under the name *Tremella aurantia.* Young, gregarious specimens bear some resemblance in aspect to *Guepinia spathularia,* especially when dried, but the spores of the latter are only 8–10 × 4–4½ μ and usually simple or finally becoming only 2-celled.

Specimens examined:

Exsiccati: Ell. & Ev., N. Am. Fungi, 1697, under the name *Tremella aurantia.*

Canada: Ontario, Lake Rosseau, *E. T. & S. A. Harper, 808;* Temagami, *H. von Schrenk* (in Mo. Bot. Gard. Herb., 57049).

New Hampshire: *W. G. Farlow* (in Mo. Bot. Gard. Herb., 5304); *Miss S. Minns,* in Ell. & Ev., N. Am. Fungi, 1697; Shelburne, *W. G. Farlow* (in Mo. Bot. Gard. Herb., 57887).

Vermont: Middlebury, *E. A. Burt,* four collections: Ripton, *E. A. Burt,* two collections; Silver Lake, Salisbury, *E. A. Burt.*

Massachusetts: *Sprague, 778,* type of *D. chrysosperma* (in Curtis Herb., 6211); Worcester, *G. E. Francis, 69.*

Connecticut: Mansfield, *P. W. Graff, 42* (in Mo. Bot. Gard. Herb., 44796).

New York: East Galway, *E. A. Burt;* Floodwood, *E. A. Burt.*

Pennsylvania: Bethlehem, *Schweinitz,* type (in Herb. Schweinitz); Carbondale, *E. A. Burt.*

South Carolina: Clemson College, *P. H. Rolfs, 4.*

Alabama: Auburn, *L. M. Underwood & F. S. Earle* (in Mo. Bot. Gard. Herb., 5299); Montgomery, *R. P. Burke, 107* (in Mo. Bot. Gard. Herb., 21009).

Louisiana: St. Martinville, *A. B. Langlois.*

Michigan: Gogebic Co., *E. A. Bessey, 47, 124, 154, 348* (in Mo. Bot. Gard. Herb., 56541, 56566, 56576, 56633, respectively).

Wisconsin: Dells of the Wisconsin (in Mo. Bot. Gard. Herb., 57889); Madison, *L. H. Pammel* (in Mo. Bot. Gard. Herb., 57888).

British Columbia: Vancouver Island, *W. Trelease, 25* (in Mo. Bot. Gard. Herb., 5298).

Washington: Bingen, *W. N. Suksdorf, 688.*

Dacryomyces abietinus (Pers.) Schroeter, more frequently referred to as *D. stillatus,* is a common European species having spores 7-septate and of the same dimensions as those of *D. palmatus.* This species occurs occasionally in the United States; it differs from *D. palmatus* in having very small, compact fructfiications which are nearly always on old, decorticated, decaying pine wood. In only one of the specimens cited below do the fructifications burst out from the bark. The name *D. stil-*

latus came into extensive use, because there was formerly a strong tendency among many European botanists to use the first binomial containing the true genus of the plant without regard to the priority of the specific portion of the binomial. When publishing and defining his new genus *Dacryomyces*, Nees, as he states, took Persoon's *Tremella abietina* and renamed it *Dacryomyces stillatus* Nees. How generally Nees was followed in this instance is shown in the following synonymy. It is fortunate that such cases as this are the exception. In passing it may be noted that Nees spelled his genus *Dacryomyces*.

D. abietinus (Pers.) Schroeter, Krypt. Fl. Schlesien **3:** 400. 1888; Coker, Elisha Mitchell Scientif. Soc. Jour. **35:** 161. *pl. 23. f. 12; pl. 63. f. 3, 4.* 1920.

Tremella abietina Persoon, Obs. Myc. **1:** 78. 1796; Syn. Fung. 627. 1801; Myc. Eur. **1:** 104. 1822.—*Dacryomyces stillatus* Nees, System, 89. *pl. 7. f. 90.* 1816; Fries, Syst. Myc. **2:** 230. 1823; Epicr. 592. 1838; Hym. Eur. 699. 1874; Berkeley, Outl. Brit. Fung. 291. *pl. 18. f. 8.* 1860; Peck, N. Y. State Mus. Rept. **22:** 88. 1869; Berk. & Curtis, Grevillea **2:** 20. 1873; Morgan, Cincinnati Soc. Nat. Hist. Jour. **11:** 94. 1888; Brefeld, Untersuch. Myk. **7:** 155. *pl. 10. f. 9–11.* 1888; Sacc. Syll. Fung. **6:** 798. 1888; Stevenson, Brit. Hym. **2:** 318. 1886; Bourdot & Galzin, Soc. Myc. Fr. Bul. **25:** 34. 1909.

Illustrations: Berkeley, *loc. cit.;* Brefeld, *loc. cit.;* Coker, *loc. cit.* See Sacc. Syll. Fung. **19:** 536. 1910, for reference to others.

Fructifications minute, usually about 2 mm. in diameter, gregarious, sometimes touching, convex and barium-yellow at first, in drying becoming flattened, pezizoid and somewhat orange or hazel (resin-colored), attached by central part of the under side; spores colored like the fructification, curved, becoming 7-septate, perhaps rarely 9-septate, 15–24 × 6–9 μ.

Fructifications 1–2 mm. in diameter in specimens studied by me, contracting in drying to 1 mm., sometimes longer by confluence.

On decaying, decorticated pine and other coniferous wood. Vermont to South Carolina. Rare, but more common in Europe. August to October.

Examination of the spores should be made in case of specimens otherwise referable to *D. abietinus*, for I find by making microscopic study of specimens in published exsiccati and in herbaria that most of the specimens labeled *D. stillatus* have spores much smaller than the dimensions given above and are not more than 3-septate; such specimens are better referable to *D. deliquescens*, the species next to be considered. In the Missouri Botanical Garden Herbarium there is a specimen from Magnus under the name *D. stillatus*, and another from Berkeley in Berkeley's 'British Fungi,' No. 164, and another in Westendorp, 'Herb. Crypt.', 139; these specimens have somewhat the aspect of what they are labeled but are composed of intricately interwoven, coarse, vermiform hyphae with elongated cells containing many vacuoles and with spore-like bodies not differentiated from the hyphae; no basidia were found. These specimens are not distinguishable from the oidium stage of *D. deliquescens*, as illustrated by Tulasne[1] and by Falk.[2]

Specimens examined:

Exsiccati: Rabenhorst, Herb. Myc., 276; Ravenel, Fungi Car. 4: 81.
Sweden: Upsala, *E. A. Burt.*
Germany: in Rabenhorst, Herb. Myc., 276.
Italy: *G. Bresadola.*
Vermont: Middlebury, *E. A. Burt.*
South Carolina: Ravenel, in Ravenel, Fungi Car. 4: 81.

D. deliquescens (Bull.) Duby, Bot. Gall. **2**: 729. 1829; Berkeley, Outl. Brit. Fung. 290. 1860; Fries, Hym. Eur. 698. 1874; Sacc. Syll. Fung. **6**: 798. 1888; Morgan, Cincinnati Soc. Nat. Hist. Jour. **11**: 94. 1888; Bourdot & Galzin, Soc. Myc. Fr. Bul. **25**: 34. 1909.

Tremella deliquescens Bulliard, Herb. de la France **1**: 219. *pl. 455. f. 3.* 1789.—*Dacryomyces minor* Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 168. *pl. 49. f. left; pl. 64. f. 1–2.* 1920.

Illustrations: Bulliard, *loc. cit.;* Coker, *loc. cit.;* Brefeld, Untersuch. Myk. **7**. *pl. 9;* Falk, Cohn's Beitr. Biol. Pflanzen **8**. *pl. 12.*

[1] Tulasne, Ann. Sci. Nat. Bot. III. **19**: 216–219. *pl. 13. f. 1–3.* 1853.
[2] Falk, Cohn's Beitr. Biol. Pflanzen **8**: *pl. 12. f. 3.* 1902.

f. 3. (oidium stage). 1902; Tulasne, Ann. Sci. Nat. Bot. III. **19**. *pl. 12. f. 13–19; pl. 13. f. 1–8.* (oidium stage). 1853.

Fructifications gregarious, small, pulvinate, avellaneo-ochraceous, somewhat wrinkled, becoming more flattened and resin-colored in drying; spores even, curved, simple, becoming 1–3-septate, 10–14 × 3½–5 μ.

Fructifications 1–5 mm. long, 1–3 mm. broad, usually only 1–2 mm. in diameter.

Usually on decorticated, partially decayed pine and other coniferous wood but sometimes on frondose species. Vermont to Alabama, westward to Missouri, and in Alaska. March to November. Common.

Dacryomyces deliquescens is characterized by its small, smoky, ochraceous or pale greenish ochraceous fructifications with somewhat wrinkled surface and spores 10–14 μ long and not more than 3-septate. In most of my American gatherings on pine the fructifications are smaller than European specimens. Peck compared one of my specimens with his type of *D. minor* and reported "The spores seem too large for this. Is it not small *D. deliquescens*?"

Specimens examined:

Exsiccati: Ellis, N. Am. Fungi, 333, under the name *D. stillatus;* Ravenel, Fungi Am., 135, under the name *D. stillatus;* Sydow, Myc. Germ., 555; de Thümen, Myc. Univ., 1209.

England: Epping Forest, *E. A. Burt.*

Sweden: Femsjö, *E. A. Burt.*

Germany: Brandenburg, *P. Vogel,* in Sydow, Myc. Germ., 555.

Vermont: Middlebury, 5 gatherings, *E. A. Burt;* Ripton, *E. A. Burt.*

New York: *Sartwell* (in Mo. Bot. Gard. Herb., 5301, 5302); Westport, *C. H. Peck.*

New Jersey: Newfield, *J. B. Ellis,* in Ellis, N. Am. Fungi, 333, and in de Thümen, Myc. Univ., 1209.

South Carolina: Aiken, *H. W. Ravenel,* in Ravenel, Fungi Am., 135.

Alabama: Montgomery County, *R. P. Burke, 533* (in Mo. Bot. Gard. Herb., 57371).

Wisconsin: Madison, *W. Trelease* (in Mo. Bot. Gard. Herb., 5303).

Missouri: Meramec Highlands, *L. O. Overholts* (in Mo. Bot. Gard. Herb., 43643).

Alaska: Sitka, *W. Trelease, 590* (in Mo. Bot. Gard. Herb., 57893); Yakutat, *W. Trelease, 598* (in Mo. Bot. Gard. Herb., 57894).

Under the name *Tremella subochracea* Peck described a species collected by himself on decorticated wood of *Populus monilifera* at Albany, N. Y. Study of his type shows this fungus to be a *Dacryomyces* having larger and more elongated fructifications than *D. deliquescens* and slenderer spores which curve to one side below the middle into a characteristic tapering, oblique base. Spores of similar dimensions and form occur in the type of *D. minor* Pk. but in the latter the fructifications are so deeply sunk in the very rotten wood that only the upper surface is visible and I could not come to a definite conclusion in regard to the species nor the wood in which growing. A collection of mine made at Middlebury, Vt., on *Salix*, is referable to *D. subochraceus.*

D. subochraceus (Peck) Burt, n. comb.

Tremella subochracea Peck, N. Y. State Mus. Rept. **34**: 43. 1881; Sacc. Syll. Fung. **6**: 788. 1888.—An *Dacryomyces minor* Peck, N. Y. State Mus. Rept. **30**: 49. 1879?

Type: in N. Y. State Mus. Herb.

"Small, two to four lines in diameter, forming interrupted or anastomosing lines or patches, gyrose plicate, pale-ochraceous, becoming darker in drying; spores oblong or oblong pyriform, slightly curved at the small end, colorless, .0004 in. to .0005 in. long, .00016 in. to .0002 in. broad. Decorticated wood of poplar, *Populus monilifera.* Albany. Sept. A peculiar feature of this species is its tendency to grow in lines which run together in a reticulate manner. The color is dingy-yellow or subochraceous."

Fig. 3. *D. subochraceus.* Basidium and spores of type × 665.

The above is the original description which is of especial value in regard to the general aspect or habit of the species, for it was undoubtedly written, according to Peck's

usage, with the entire gathering of material in fresh, vegetative condition before him. In the specimens constituting the type, the fructifications while small for a *Tremella*, as published by Peck, are large for a species of the *Dacryomyces deliquescens* group, being up to 7 mm. long, ½–¼ mm. broad, now fuscous in dried condition and ochraceous drab and with surface wrinkled when softened by wetting; basidia cylindric, 30 × 4 μ, with 2 obtuse, divergent sterigmata, 4½–6 × 1½ μ; spores continuous at first, mostly 1-septate, but becoming 3-septate, 9–13 × 3–4 μ, curving below into a tapering, oblique base.

On *Populus* and *Salix*. Vermont and New York. September and November. Probably rare.

Specimens examined:

Vermont: Middlebury, *E. A. Burt.*

New York: Albany, *C. H. Peck*, type (in N. Y. State Mus. Herb.).

Still another species of the *D. deliquescens* group with large fructifications of the aspect of those of *D. subochraceus* but with broader, less curved spores was published independently by Coker and by Bresadola in 1920. This species has spores of the same dimensions and form as those of *D. deliquescens* but fructifications larger, drying paler, and occurring on frondose wood only, agreeing in these features with *D. subochraceus*. The description by Coker was published a few weeks earlier than that by Bresadola, hence the name of this species, if not too close to *D. subochraceus*, is

D. Ellisii Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 167. *pl. 23. f. 11; pl. 50; pl. 63. f. 8.* 7 Jl. 1920.

D. Harperi Bresadola, Ann. Myc. **18**: 53. 31 Ag. 1920.

Illustrations: Coker, *loc. cit.*

Gregarious, bursting through the bark and forming subglobose or pulvinate, crumpled, firmly gelatinous masses, orange or wine-colored, fading to olive-buff and drying sepia and with surface plicate-gyrose, the base whitish and buried in the bark; spores hyaline under the microscope, noted by Coker as orange in spore collections, 12 × 5–6 μ.

Dried fructifications 3–5 × 2–3 mm., and 2 mm. high.

On bark of dead limbs of alder, oak, and other frondose spe-

cies. Massachusetts to North Carolina and in Wisconsin and Illinois. October to February. Rare.

D. Ellisii is thicker and more pulvinate than *D. deliquescens* and has the hymenium more plicate-gyrose, broader spores, a whitish basal portion, visible upon dissecting away the outer bark, and it occurs on bark-covered limbs of frondose species; the aspect is suggestive of a *Tremella*.

Specimens examined:

Wisconsin: Madison, *W. Trelease* (in Mo. Bot. Gard. Herb., 5358).

Under the name *Dacryomyces fragiformis* (Pers.), Ellis distributed in Ell. & Ev., N. Am. Fungi, 2607, an infrequent northern species of which the specimens were collected on dead limbs of yellow birch at London, Canada, by Professor J. Dearness. *D. fragiformis* was published by Persoon as *Tremella fragiformis* and described by him as a red species occurring on dead branches of pine; in his illustration the wood is decorticated. The original description and illustration present a fungus very different from our species on birch, which is of pezizoid aspect, with yellow hymenium and white stem, and is referable to *Ditiola conformis* Karst.

Ditiola conformis Karsten, Notis. ur Sällsk pro Fauna et Flora Fennica Förh. **11**: 223. 1871; Finska Vet.-Soc. Bidrag Natur och Folk **48**: 461. 1889; Soc. Sci. Fenn. Actis **18**: 110. *pl. 6. f. 80.* 1891; Sacc. Syll. Fung. **6**: 813. 1888.

An *Guepinia Femsjoniana* Olsen in Brefeld, Untersuch. Myk. **7**: 161. *pl. 11. f. 3–5.* 1888?

Illustrations: Karsten, *loc. cit.*

Type: Type distribution in Karsten, Fungi Fenn. Exs., 629.

Fructifications erumpent through the bark, stipitate, solitary and pezizoid or cespitose and becoming confluent and then forming pulvinate masses with hymenial surface plicate, cinnamon-buff to ochraceous buff; stem expanding above, white-floccose; basidia bifurcate; spores yellow in spore collection, simple at first, then pluriguttulate, finally 1–7-septate, 18–28 × 7–9 μ.

Dried fructifications 2 × 2–4 mm.; confluent masses 5–12 × 5–7 mm.; stem up to 4 mm. long.

On fallen decaying branches of *Betula lutea* in mountain forests (reported by Karsten on *Alnus incana*). Ontario, Vermont, and New York. August, February, and March. Rare.

Reference of our specimens to *Ditiola conformis* has been confirmed by comparison with the type distribution by Karsten cited above; and they agree well with the description and illustration by Karsten although in America forming pulvinate masses by confluence of the hymenial portions of a cluster of fructifications. They are certainly cogeneric with *Ditiola radicata*, which I collected abundantly in Sweden but have not yet found in the United States.

Specimens examined:

Exsiccati: Karsten, Fungi Fenn. Exs., 629; Ell. & Ev., N. Am. Fungi, 2607, under the name *Dacryomyces fragiformis.*

Canada: Ontario, London, *J. Dearness*, in Ell. & Ev., N. Am. Fungi, 2607.

Vermont: Ripton, Abby Pond, *E. A. Burt*, and Lost Pleiad Pond, *E. A. Burt.*

New York: Catskill Mts., *C. H. Peck* (in N. Y. State Mus. Herb.).

As *Tremella stipitata*, Peck described a species which has furcate basidia and spores simple at first but becoming 1-septate. The presence of a stem places this species in the genus *Dacryomitra*, as follows:

Dacryomitra stipitata (Peck) Burt, n. comb. Plate 3, figs. 3, 4.

Tremella stipitata Peck, N. Y. State Mus. Rept. **27**: 100. *pl. 2. f. 22, 23.* 1875; Sacc. Syll. Fung. **6**: 788. 1888; as *Coryne* Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 150. 1920.—An *Dacryopsis ceracea* Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 175. *pl. 50. f. 1; pl. 65. f. 3, 4.* 1920?

Illustrations: Peck, *loc. cit.*

Type: in N. Y. State Mus. Herb.

"Head small, tremelloid, subglobose or irregular, glabrous,

more or less uneven with gyrose convolutions, yellow, often changing to orange or reddish brown in drying; stem distinct, firm, solid, nearly equal, yellow, often tinged with brown at the base, rarely throughout its whole extent, sometimes divided at the top into two branches, each bearing a head"; basidia forked, about 25 × 2½ μ, bearing two divergent, obtuse sterigmata about 6–9 × 2 μ; spores hyaline, even, simple at first, becoming 1-septate, 7–9 × 3 μ.

Fig. 4. *D. stipitata*. Basidium and spores of type × 665.

Fructifications 1–2 cm. high.

"On decaying wood in swamps. Forestburgh, New York. September.

"The texture of the stem is very unlike that of the head. The color of the stem generally fades to whitish or pallid in drying. The stem is sometimes slightly recurved at the top and appears to penetrate the receptacle as in the genus *Spathularia*. Barren stems occur obtusely pointed at the apex and destitute of a head."

I have the impression that I saw at one time an ample collection of the above species from New Hampshire in Farlow Herb., but I could not locate these specimens recently when desiring to make sure that their microscopic characters were like those of Peck's type. *Dacryomitra dubia* as understood by Coker appears distinct by its much larger spores. Authentic *D. dubia* Lloyd, communicated by Miss Hibbard to Lloyd, should be compared with *D. stipitata*.

A stipitate species related to the preceding was originally published as *Exidia pedunculata* B. & C. and has recently been transferred to *Dacryomyces* by Coker, but I can not reconcile the illustrations and description of his specimens with the type of *Exidia pedunculata* in its dried condition in Curtis Herbarium; it seems to me that *Dacryomyces pedunculatus* Coker is a very different species, for the original specimens of the former have slender, sulcate stems ½ mm. in diameter, standing up 1–2 mm. above the woody substratum and bearing at the top of each a small fertile head about 1 mm. in diameter, the general aspect of the whole fructification somewhat resembling that of a stipi-

tate Myxomycete. Since the older genus *Dacryomitra* is so broadly defined that it includes Massee's genus *Dacryopsis*—which has always been superfluous—I transfer *E. pedunculata* to *Dacryomitra:*

D. pedunculata (Berk. & Curtis) Burt, n. comb.

Exidia pedunculata Berkeley & Curtis, Grevillea **2**: 19. 1873; Sacc. Syll. Fung. **6**: 773. 1888.—Not *Dacryomyces pedunculatus* Coker, Elisha Mitchell Scientif. Soc. Jour. **35**: 166. *pl. 23. f. 15; pl. 41. f. 4; pl. 62. f. 4, 5.* 1920.

Type: in Curtis Herb. and probably in Kew Herb.

About 4 mm. high, horn color; stem erect, sulcate, bearing at the apex the expanded, lobed, and at length deflexed hymenium, about 2 mm. across; at first tuberculiform and attached by a white, floccose mycelium, which at length entirely vanishes; basidia 40–50 × 3 μ, bearing 2 divergent, obtuse sterigmata up to 15 × 3 μ; spores hyaline under the microscope, thick-walled, becoming 3-septate, 13–18 × 6–8 μ.

Fig. 5. *D. pedunculata.* Basidium and spores of type × 665.

Dried fructifications of the Curtis Herb. specimens have heads 1 mm. in diameter, and stems 1–2 mm. long, ½ mm. in diameter.

On pine wood. South Carolina.

D. pedunculata is distinct from *D. stipitata* by much larger spores which become 3-septate. In its spore characters and occurrence on pine it agrees with *D. dubia* as understood by Coker, with dried specimens of which it should be compared.

Dacryopsis Ellisiana Massee, Jour. Myc. **6**: 181. *pl. 7. f. 19–21.* 1891; Sacc. Syll. Fung. **11**: 150. 1895.—See Massee, Torr. Bot. Club Bul. **28**: 519. 1901, and Durand, Torr. Bot. Club Bul. **28**: 349. *pl. 26*, and 646. 1901.

Under the above name Massee published as a Basidiomycete an erroneous account of the structure of *Coryne Ellisii* Berk., a synonym of *Stilbium giganteum* Pk. and the imperfect stage of *Holwaya gigantea* (Pk.) Durand. The material which Massee studied was collected by Ellis at Potsdam, N. Y. I made abundant gatherings of the species on a basswood log at Middle-

bury, Vt., finding also specimens associated with the ascosporic stage. In 1899, I compared my material with the type of *Dacryopsis Ellisiana* in Kew Herb., making preparations of the latter, which I still have, and studying them critically until convinced that no basidia were present and that my Middlebury gatherings agreed in all respects with the type. With regard to the final paragraph of Professor Durand's note to which reference is made above, it was published without my knowledge and I have never concurred in it. I studied the type, of which there is without doubt duplicate material in N. Y. Bot. Gard. Herb.; as a *Dacryopsis, Coryne Ellisii* Berk. is merely a myth of mycology.

AURICULARIACEAE

On a log of decayed balsa wood, *Ochroma lagopus*, received from Costa Rica, there developed in Dr. von Schrenk's rotting pit in the Missouri Botanical Garden, during April and May, 11 fructifications in various stages of development, of a tropical species of *Auricularia*, which seems undescribed, although specimens of the same species were collected in Cuba about 65 years ago and distributed by Wright under the name *Hirneola auriformis* (Schw.) Fr., from authentic specimens of which they certainly differ as noted by Farlow.[1]

The log on which the present gathering grew was decorticated, badly decayed, cylindric, 30 cm. in diameter by 10 cm. long, and stood erect on one end on the moist material of the rotting pit like a stump in position in the ground. Most of the first fructifications were on the least-illuminated side of the log, where they appeared at first as velvety, tubercular outgrowths 2 mm. long and 1 mm. in diameter, with obtuse ends, standing out perpendicularly from the side of the log. When 5 mm. long, the fructifications were still cylindric but curving downward at an angle of 45 degrees with the log; when 1–1½ cm. long the free end of the fructification assumed the form of a shallow cup with the concave surface facing the ground and developing an inferior hymenium, pl. 3, fig. 6. In this stage the supporting stem was attached to the center or very near

[1] Farlow, W. G. Bibliog. Index N. Am. Fungi 1: 305. 1905.

the center of the upper side of the pileus. In the full-grown specimens the pendant pileus expanded in a horizontal plane eccentrically to a diameter of from 6–9 cm. but with only about one-fifth of the whole diameter between the side of the log and where the stem passes into the pileus, as shown in fig. 7. Usually a short stem is present, not more than 1 cm. long, flattened, and 1 cm. in greatest diameter where it joins the pileus. The stem contracts so greatly in drying that the dried fructifications appear sessile.

In May some fructifications matured on the upper end of the log. These fructifications were cup-shaped at first, becoming expanded later, and having the hymenium superior and the stem central. In both cases, whether the pileus was pendant and with its hymenium inferior or erect and with hymenium superior, the hymenium, fig. 8, was on the surface opposite or most distant from the stem. In this connection it may be recalled that before *Hirneola* was made a synonym of *Auricularia* on account of its development the former was distinguished from the latter by a superior hymenium for *Hirneola* and an inferior one for *Auricularia*.

Stem and adjacent surface of pileus are minutely velvety with short hairs when highly magnified but to the naked eye have merely the dull texture of the petal of a rose. The color of the whole plant is somewhat shell-pink in growing specimens but became darker in drying, passing through shades of vinaceous, and finally became deep brownish drab of Ridgway, somewhat translucent, and minutely velvety. The hymenium was somewhat shining and glabrous and afforded a copious spore-fall of white spores. The flesh of the interior of the pileus was highly gelatinous, but the consistency of the whole fructification was coriaceous and pliant as rubber. For this species the following name is proposed:

Auricularia rosea Burt, n. sp. Plate 3, figs. 6–8.

Type: in Mo. Bot. Gard. Herb.

Fructifications gregarious, orbicular, peltate, erect or pendant by a short stem which contracts in drying—often to a mere point of attachment—or rarely sessile from the first, soft, pliant, gelatinous within, somewhat shell-pink when grow-

ing, in drying becoming vinaceous and at length deep brownish drab, somewhat translucent, the stem and adjacent surface drying minutely velvety with hairs 20–35 × 3–4 μ; hymenium on the side opposite the stem, glabrous, even or with one or two shallow folds radiating from the stem; basidia flexuous,transverscly septate, 30–40 × 4 μ; spores white in spore collection, simple, curved, 12 × 4 μ.

Fructifications 6–9 cm. in diameter; stem, if present, up to 1 cm. long when growing.

On logs of decaying balsa wood from Costa Rica, and in Cuba.

This species may be recognized by its very thin, somewhat translucent, applanate, peltate, pendant or erect pilei of shell-pink color and texture of a rose petal when growing, and by the hymenium more even than in other species.

This species should be compared with *Auricularia lenta*, described by Fries from specimens collected at Mirador, Brazil, and known to me from only the description, with which *A. rosea* agrees in several respects.

Specimens examined:

Costa Rica: on log from there, type (in Mo. Bot. Gard. Herb., 57898).

Cuba: *C. Wright, 286* (in Curtis Herb., under the name *Hirneola auriformis*).

There is another tropical *Auricularia* of more frequent occurrence in herbaria than the preceding species. It is

A. delicata (Fries) Hennings, Engler's Bot. Jahrb. **17**: 492. 1893; Farlow, Bibl. Index N. Am. Fungi **1**: 306. 1905; Lloyd, Myc. Writ. **5**. Myc. Notes 55: 784. *text f. 1177*. 1918.

Plate 3, fig. 5.

Laschia delicata Fries, Linnaea **5**: 533. 1830; Epicr. 499. 1838; R. Soc. Sci. Upsal. Acta III. **1**: 105. 1851; Sacc. Syll. Fung. **6**: 407. 1888.—*L. tremellosa* Fries, Summa Veg. Scand. 325 (foot note). 1849; R. Soc. Sci. Upsal. Acta III. **1**: 105 (as synonym). 1851; Sacc. Syll. Fung. **6**: 407. 1888.—*Auricularia tremellosa* (Fries) Patouillard, Jour. de Bot. **1**: 226. *pl. 4. f. 9, 10.* 1887; Farlow, Bibl. Index N. Am. Fungi **1**: 309. 1905.

Illustrations: Lloyd, *loc. cit.;* Patouillard, *loc. cit.*

Somewhat orbicular or shell-shaped, sessile and attached by

the margin or marginate all around and pendant by a short stem attached to the upper side near the margin, drying very thin, somewhat translucent, buffy brown to fuscous, with upper surface more or less minutely velvety and somewhat veined; hymenium inferior, forming rather deep, angular pores about 1–2 mm. in diameter and about half as deep in the dried herbarium specimens, with the more prominent walls somewhat radiating from the stem; basidia flexuous, transversely septate, 30–45 × 4½–5½ μ; spores hyaline, even, simple, curved, 9–12 × 4–5½ μ.

Dried fructifications 2–4 cm. in diameter and ½ mm. thick.

On dead wood. West Indies and Mexico. December to April.

This species is distinguished by having its hymenium in irregular folds and pits, as in *Merulius tremellosus*, to so marked a degree that dried specimens are likely to be regarded as a dark species of *Merulius*, from which the slender, transversely septate basidia readily separate it.

Specimens examined:

Exsiccati: Smith, Central American Fungi, 142.

Cuba: *C. Wright* (in Curtis Herb.).

Jamaica: Balaklava, *A. E. Wight, 306, 309,* and *342* (in Farlow Herb.).

Mexico: Jalapa, *C. L. Smith,* in Smith, Cent. Am. Fungi, 142; Motzorongo, *J. G. Smith* (in Mo. Bot. Gard. Herb., 480); Orizaba, *J. G. Smith* (in Mo. Bot. Gard. Herb., 4066).

There occurs throughout North America on prostrate, decaying trunks and limbs of *Populus tremuloides* a common and conspicuous species which I have determined during many years for my correspondents as *Phlebia strigoso-zonata* (Schw.), for I had compared my collection with the type of *Merulius strigoso-zonatus* Schw. in Herb. Schweinitz. The combination *Phlebia strigoso-zonata*, with the alternative *Auricularia strigoso-zonata* (Schw.) Lloyd under his pseudonym McGinty, was finally published by Lloyd, Myc. Writ. 4: Letter 46: 6. 1913, and regarded as synonymous with a species of the Far East known as *Auricularia rugosissima* (Lév.) Bres., as well as by other names.

Auricularia rugosissima is known to me by the specimen from

the Philippine Islands distributed in Sydow, Fungi Exot. Exs. 321, as well as by two other Philippine collections, viz., that from E. D. Merrill, 3508, and the other by H. M. Curran, Forestry Bureau, 8907.

There is a close resemblance in aspect and coloration between the above-mentioned specimens of *A. rugosissima* and our American *Phlebia strigoso-zonata*, but the latter has simple basidia bearing 4 spores at the apex on slender sterigmata. The demonstration of these basidia is easy, for in a fertile specimen the mature basidia protrude beyond the dense, compact, dark layer of hymenial hairs and stand out conspicuously, bearing their spores. One should disregard the difficult structure of this dark layer and run along its edge in the section for the more or less scattered exserted basidia. My demonstration has been confirmed many times by members of my classes in mycology who have used fertile specimens of this species in laboratory work in determination of genera.

Hence *Merulius strigoso-zonata* Schw. is not a species of *Auricularia* but should be included in *Phlebia* on account of the configuration of its hymenium and simple basidia. The present status of this species so far as known to me from examination of authentic specimens is as follows:

Phlebia strigoso-zonata (Schw.) Lloyd, Myc. Writ. **4**. Letter 46: 6. 1913; Kauffman, N. Y. State Mus. Bul. 179: 88. 1915.

Merulius strigoso-zonatus Schweinitz, Am. Phil. Soc. Trans. N. S. **4**: 160. 1832.—*Auricularia strigoso-zonata* (Schw.) Lloyd, Myc. Writ. **4**. Letter 46:6. 1913.—*Phlebia rubiginosa* Berkeley & Ravenel in Ravenel, Fungi Car. **3**: 23. 1855; Grevillea **1**: 146. 1873; Sacc. Syll. Fung. **6**: 499.—*P. pileata* Peck, N. Y. State Mus. Rept. **29**: 45. 1878; Sacc. Syll. Fung. **6**: 499. 1888. —An *Phlebia orbicularis* Berkeley & Curtis, Hooker's Jour. Bot. **1**: 237. 1849, and Grevillea **1**: 146. 1873?

Type: in Herb. Schweinitz.

Fructifications coriaceous, resupinate or effuso-reflexed, with the pilei more or less imbricated and laterally confluent, concentrically sulcate, zonate, somewhat tomentose, drying Natal-brown or Hay's brown, with usually 1–3 narrow, darker, alternating zones; hymenium becoming crowded with slightly elevated,

radiating folds or wrinkles which are frequently interrupted, drying fuscous to fuscous-black and finally suffused with a bloom, the margin red or orange when young; basidia simple, hyaline, protruding beyond the dark zone of hymenial hairs, 12–15 × 3–4 μ, bearing 4 slender sterigmata 4½ μ long; spores white in collection on slide, flattened on one side, 6–8 × 3–4 μ.

Resupinate fructifications 1–5 cm. in diameter; reflexed fructifications have reflexed part up to 5–15 mm. long and resupinate portion up to 10 cm. in diameter.

Common on poplar, reported on beech and oak also. Ontario to South Carolina and westward to Manitoba, Minnesota, and Arkansas. August to December.

Early in its season the fructifications of this species are small, resupinate, brighter red than later, and with the hymenium nearly even and not yet fertile. The type specimen of *P. orbicularis* has the aspect of an immature specimen of *P. strigoso-zonata*, but it may prove distinct since it was collected on *Quercus*; in its native region, it should be followed through the season until it gives good spore collections in order that mature specimens may be available for comparison with *P. strigoso-zonata*. Specimens referable to the latter were distributed under various names in Ell. & Ev., N. Am. Fungi, 2731, and 3416, the latter being fertile, in Ravenel, Fungi Car. **3**: 23, and in Shear, N. Y. Fungi, 47.

Helicobasidium Peckii Burt, n. sp.

Type: in Mo. Bot. Gard. Herb. and N. Y. State Mus. Herb.

Fructification resupinate, effused, coriaceous, separable, drying with the subiculum loosely interwoven and army-brown and the hymenium avellaneous, even, dry, glabrous, not at all gelatinous or waxy; in structure 800–1200 μ thick, composed of loosely interwoven, stiff, colored hyphae 4½ μ in diameter, not nodose-septate, not incrusted, darkest next to the substratum; basidia curved or hook-shaped, becoming transversely 3-septate, with the sterigmata distributed one to each cell on the convex side; spores hyaline, even, flattened on one side, 9 ×6 μ, copious.

Fig. 6. *H. Peckii.* Young basidium, *b'*, mature basidia, *b*, and spores, *s*, type, × 665.

Fructification 4 cm. in diameter.

On spruce bark. Adirondack Mts., N. Y. June 7, 1905. Probably rare.

The general appearance of *H. Peckii* is that of a *Corticium*, *Coniophora*, or *Hypochnus*, with the coffee-colored hymenium covering the reddish brown subiculum. The basidia are not crowded together as closely as in most species of *Corticium* and show well their hook-shaped form when thin sections are examined. *Helicobasidium* is a small genus and has not been recorded heretofore for America. I am indebted for the privilege of studying the present specimen to Dr. H. D. House who found it among the undetermined collections of Peck, to whose memory I dedicate the species in grateful regard for assistance and friendship which began in 1879.

EXPLANATION OF PLATE

PLATE 3

All figures natural size.

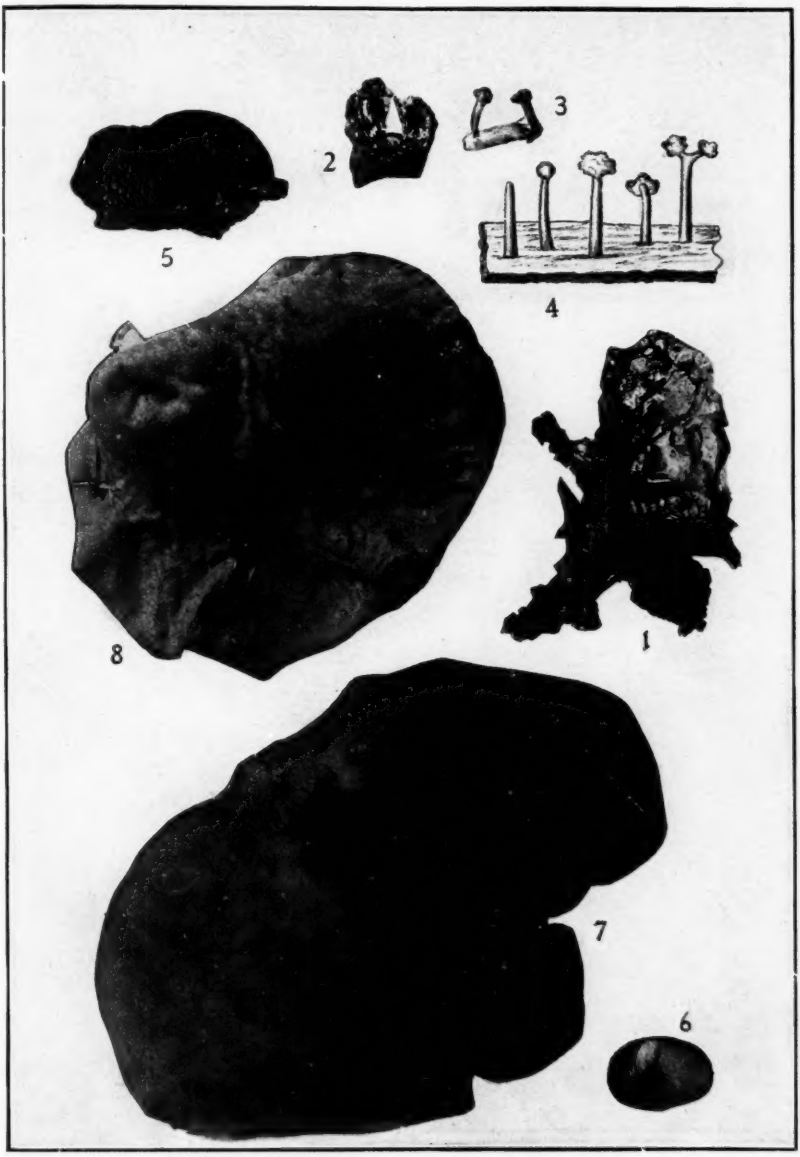
Fig. 1. *Tremella concrescens.* From type of *Dacryomyces pellucidus* in Herb. Schweinitz.

Fig. 2. *Dacryomyces palmatus.* From type of *Tremella palmata* in Herb. Schweinitz.

Figs. 3, 4. *Dacryomitra stipitata* Fig. 3, from the type in N. Y. State Mus. Herb., Fig. 4, after the illustration in N. Y. State Mus. Rept. **27**. pl. 2. f. 22.

Fig. 5. *Auricularia delicata.* Collected at Motzorongo, Mexico, by J. G. Smith, in Mo. Bot. Gard. Herb.

Figs. 6–8. *Auricularia rosea.* From the type in Mo. Bot. Gard. Herb., Fig. 6, small fructification in fresh condition; Figs. 7 and 8, mature fructification in vegetative condition, 7, showing stem and adjacent surface and, 8, hymenial surface.



BURT—TREMELLACEAE, DACRYOMYCETACEAE, AND AURICULARIACEAE

GENERAL INDEX TO VOLUME VIII

New scientific names of plants and the final members of new combinations are printed in **bold face** type; synonyms and page numbers having reference to figures and plates, in *italic;* and previously published scientific names and all other matter, in ordinary type.

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